Engineering Library

"THE ENGINEER," SEPTEMBER 27, 1929

With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CXLVIII.—No. 3846] LONDON: FRIDAY EVENING, SEPTEMBER 27, 1929 [PRICE {WITH SUPPLEMENTS} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Director-General, India Store Department, Belvedere road, Lambeth, London, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—90 CONNECTING RODS for LOCOMOTIVES.

SCHEDULE 2.—DULPICATE PARTS for LOCOMOTIVES.

Tenders due as follows :—
Schedule 1, 4th October, 1929.
Schedule 2, 23rd October, 1929.
Forms of Tender available from the above at a fee (which will not be returned) of 5s. for each Schedule. 3314

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for :—
3122 WAGONS, 5ft. 6in. gauge.
492 UNDERFRAMES for CARRIAGES, 5ft. 6in. gauge.
1657 WAGONS, metre gauge.
206 UNDERFRAMES for CARRIAGES, metre gauge.

5477

Tenders due Monday, 21st October, 1929, before 10.30 a.m.
Forms of Tender available from the above at a fee of 5s., which will not be returned. 3313

Crown Agents for the COLONIES.
COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POSTS :—

M/1740.—ASSISTANT HARBOUR ENGINEER REQUIRED by the GOVERNMENT of the GOLD COAST for the Takoradi Harbour, for a tour of 6 to 12 months' service. Salary £480 a year for the first three years of service and then £510, rising to £720 by annual increments of £30, and thence to £920 a year by annual increments of £40. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, age 25 to 35, must have passed "A" and "B" of the examinations to qualify for the A.M.I.C.E. Diploma or hold professional qualifications recognised by the Institution of Civil Engineers as exempting from those examinations. Should have had some civil engineering experience outside pupilage, preferably on harbour and dock works.

M/1799.—ASSISTANT ENGINEER REQUIRED by the GOVERNMENT of IRAQ for the PUBLIC WORKS DEPARTMENT for a period of three years in the first instance. Salary Rs. 800 a month, rising by annual increments of Rs. 50 to Rs. 1300 a month, with commencing salary payable according to age and qualifications. Income tax payable, amounting to approximately Rs. 17 a month on the minimum salary of appointment (Rs. 800 a month). Free passages provided by the Government. Candidates, age 26 to 30 years, should be Associate Members of the I.C.E. or hold equivalent professional qualifications and should have had several years' experience in the erection of public buildings or in the Roads Branch of a County Surveyor's Department, preferably both.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made. 3297

Vacancies for Aero-NAUTICAL EXAMINERS, AERONAUTICAL INSPECTION DIRECTORATE.

Qualifications required : good general and technical education, thorough engineering training with experience in the testing aircraft metallic and non-metallic materials, thorough knowledge of construction of aircraft components, assembly of complete aircraft and testing installation of aero-engines.

Annual salary £175-£10-£225 plus Civil Service bonus (present aggregate £259-£322).

Apply, SECRETARY, Air Ministry (I.G.), Kingsway, W.C. 2. 3247

Heriot-Watt College, EDINBURGH.

FULL TIME DAY DIPLOMA COURSES.
MECHANICAL ENGINEERING
ELECTRICAL ENGINEERING
MINING and OIL ENGINEERING
APPLIED CHEMISTRY and BREWING
BUILDING.

AUTUMN TERM BEGINS OCTOBER 15th.

Full particulars from the College.
J. CAMERON SMAIL, O.B.E., Principal. 2609

City of Cardiff Education Committee.
THE TECHNICAL COLLEGE.

Principal . . CHARLES COLES, B.Sc. (Lond.).

The SERVICES will be REQUIRED in January next of a FULL-TIME ASSISTANT LECTURER in ENGINEERING, qualified to teach up to Honours B.Sc. standard. The main subjects required will be those of Mechanical Engineering and Civil Engineering, but a good knowledge of Electrical Engineering will be a recommendation.

Salary payable according to the Burnham Award.

Applications on foolscap paper, stating age, full qualifications, teaching and other experience, and giving copies of not more than three recent testimonials, should reach the Principal (from whom further particulars may be obtained) on or before Saturday, 5th October.

The successful candidate will be required to pass a medical examination by the Authority's Medical Examiner for Teachers at Cardiff before commencing duties, and to contribute under the Teachers (Superannuation) Act, 1925.

THOMAS McHOWAT,
Director of Education.
City Hall, Cardiff. 3219

The Engineer

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PUBLIC NOTICES

Derby Technical College.

APPLICATIONS are INVITED for the POST of PRINCIPAL.

Commencing salary £800 per annum.

Particulars from the undersigned on receipt of stamped addressed foolscap envelope.

F. C. SMITHARD,
Secretary to the Derby Education Committee.
Education Offices,
Becket-street, Derby.
20th September, 1929. 3258

Harris Institute, Preston.

The Council invite APPLICATIONS for the POST of FULL-TIME HEAD of the MECHANICAL and ELECTRICAL ENGINEERING DEPARTMENT.

Candidates should possess good academic qualifications and should have had workshop and teaching experience.

Commencing salary £500 to £600 per annum.

Further particulars and form of application may be obtained from the undersigned, to whom completed forms should be returned not later than Tuesday, October 1st, 1929.

E. C. MOYLE,
Principal.
3200

Imperial College of Science AND TECHNOLOGY.
CITY AND GUILDS (ENGINEERING) COLLEGE.
DEPARTMENT OF ELECTRICAL ENGINEERING.

APPLICATIONS are INVITED for the APPOINTMENT of ASSISTANT PROFESSOR in ELECTRICAL ENGINEERING, City and Guilds (Engineering) College, commencing 1st January, 1930. Salary £600 per annum, with membership of Federated Superannuation System for Universities.

Candidates should have previous teaching experience, and practical experience of a responsible nature in the generation and application of electrical power for purposes other than telegraphy or wireless.

Applications should be made by 1st November, 1929, to the SECRETARY to the DELEGACY, City and Guilds (Engineering) College, Exhibition-road, South Kensington, S.W. 7, from whom further particulars may be obtained. 3248

PUBLIC NOTICES

Egyptian Government.

The Mechanical Department of the Ministry of Public Works, Cairo, is calling for TENDERS for the SUPPLY and ERECTION at site of Khattara Pumping Station of TWO DIESEL PUMPING UNITS. Tenders are due in Cairo not later than Noon, 25th November, 1929.

Copies of the necessary specification and conditions of Tender are available for issue on application to the CHIEF INSPECTING ENGINEER, Egyptian Government, 41, Tothill-street, S.W. 1, against remittance of £1 0s. 6d., which sum is not returnable.

A copy of these documents is also available for scrutiny at the above address. 3299

Port of London Authority.

The Port of London Authority are prepared to receive TENDERS for the EXECUTION for three years from the 1st April, 1930, of certain CONSTRUCTIONAL WORKS and REPAIRS to the BUILDINGS, RAILWAYS, ROADS and PREMISES (including River Banks, Towpaths and Shores) belonging to them or under their control.

The conditions of contract, specification, form of Tender and schedule of prices can be obtained on written application from the Engineer, Port of London Authority, London, E.C. 3, on making a deposit of £3 (cheques to be made payable to the Treasurer, Port of London Authority). The sum so paid will be refunded on receipt of a bona fide Tender and/or the return of the documents referred to.

Tenders, to be made out on the form provided, are to be returned on or before 10 a.m. on Thursday, 31st October, 1929.

The Port of London Authority do not bind themselves to accept the lowest or any Tender.

J. D. RITCHIE,
Port of London Authority, Secretary.
London, E.C. 3,
20th September, 1929. 3184

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, invite TENDERS for—

FOUR LOCOMOTIVE BOILERS, "M/S" Class, Superheated (metre gauge).

Tenders are due in on Tuesday, 15th October, 1929, by 2.00 p.m.

Tender form obtainable at address below ; fee, ONE GUINEA, WHICH IS NOT RETURNABLE.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices :
25, Buckingham Palace-road,
Westminster, S.W. 1. 3274

PUBLIC NOTICES

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Friday, 18th October, TENDERS for the SUPPLY of

ZINC WHITE.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices : The White Mansion,
91, Petty France, Westminster, S.W. 1,
24th September, 1929. 3298

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—
1. POINTS and CROSSINGS, &c.
2. SPARE PARTS for CARRIAGES and WAGONS.
3. CANVAS.
4. BEST YORKSHIRE IRON, MADRAS IMPROVEMENTS—ELECTRIFICATION of SUBURBAN SERVICES.
5. POWER SIGNALLING.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked :—"Tender for Points and Crossings," or as the case may be, with the name of the firm Tendering, must be left with the undersigned not later than Twelve Noon on Friday, the 11th October, 1929, in respect of Specifications Nos. 1 to 4, and not later than Twelve Noon on Friday, the 8th November, 1929, in respect of Specification No. 5.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specification No. 1, of 5s. for each copy of Specification No. 2, of 2s. 6d. for each copy of Specifications Nos. 3 and 4, and of £1 for each copy of Specification No. 5.

Copies of the drawings may be obtained at the Offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France,
Westminster, S.W. 1,
25th September, 1929. 3310

South Indian Railway Company, LIMITED.
SALE OF TURBINE STEAMSHIPS "ELGIN" AND "HARDINGE."

TENDERS are INVITED by the South Indian Railway Company, Limited, for the PURCHASE of the above STEAMERS, which are now employed as ferry steamers for the Indo-Ceylon Railway, Connection between the Island of Rameswaram, South India, and Talaimanaar in the Island of Ceylon.

Short particulars and conditions of Tender can be obtained on application at the Company's Offices, 91, Petty France, Westminster, S.W. 1. 3300

Egyptian State Railways.
APPOINTMENT OF AN ENGINEER FOR BRIDGES DEPARTMENT.

APPLICATIONS are INVITED for APPOINTMENT as ENGINEER in the Bridges Department of the Egyptian State Railways, Telegraphs and Telephones Administration.

Applicants must be of British nationality and 30-35 years of age. They should have considerable experience as contractors' engineers in charge of public works, including Heavy Foundations, and be thoroughly conversant with the best use of up-to-date plant ; also of costing.

Duties would be to visit construction works in progress—mostly masonry—to supervise and accelerate execution by the Bridges Department, to arrange for the supply of departmental plant, to indicate to local superintendents its most efficient and economical use, and to control costs.

Salary, £E600 per annum (£E1 equals £1 0s. 6d. approx.), free of Egyptian Income Tax.

When duty necessitates absence from Cairo, a travelling allowance of 80 Piastres per night will be allowed (100 Piastres equals £E1).

Contract in first instance until 27th December, 1930, subject to renewal.

The appointment is subject to medical examination.

The selected candidate will be granted a transfer allowance equal to one month's salary for change of residence from England to Egypt and also vice versa.

Application form and specimen contract may be obtained from—

THE CHIEF INSPECTING ENGINEER,
Egyptian Government,
41, Tothill-street,
London, S.W. 1.

to whom they should be returned with full particulars as to education, qualifications, previous experience, personal reference, and COPIES of certificates or testimonials.

Envelopes to be inscribed "Engineer for Bridges Department." 3282

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PUBLIC NOTICES

Administrative County of LONDON.

The London County Council REQUIRES a TECHNICAL ASSISTANT in the Engineering Section of the Inspectional Branch of the London Fire Brigade, in connection with Fire and Safety Matters in Buildings licensed for public entertainment in London. Candidates (under 26 years of age on 31st October, 1929) should either possess Certificates or Diplomas in Mechanical and Electrical Engineering from a recognised training college or have received a good theoretical and practical training, and should be able to submit written reports. Experience in a commercial firm or in engineering work under commercial conditions is also desirable. Prospects of promotion to permanent staff for capable assistant. Only natural-born or naturalised British subjects eligible. Salary at rate of £180 a year (basic). With present temporary fluctuating additions, remuneration is about £272 a year. Next revision of additions will take place not earlier than 1st January, 1930. Applications, in writing, to be made to Chief Officer, London Fire Brigade, Southwark Bridge-road, S.E. 1, not later than 19th October, 1929. Canvassing disqualifies.

MONTAGU H. COX,
3280 Clerk of the London County Council.

Ashton-under-Lyne, Stalybridge and Dukinfield (District) Waterworks Joint Board.

APPLICATIONS are INVITED for the APPOINTMENT of ASSISTANT ENGINEER.

Candidates must be able to prepare plans, specifications and estimates for new work and also to supervise the construction of same. The duties will include the following :—The routine work of a Water Engineer's office supplying a population of 140,000 persons, the carrying out of repair work to the impounding reservoirs (7) and the gathering grounds (33,000 acres), the keeping of plans of all new mains within the area of supply up to date, the plotting on of new housing schemes, and the preparation of all drawings and other work necessary, also keeping in repair two mechanical filtration plants dealing with 5 million gallons per day.

The successful candidate must be capable of taking charge, when necessary, in the absence of the Engineer.

The appointment will be subject to one month's notice on either side, and to the provisions of the Local Government and Other Officers' Superannuation Act, 1922. The statutory contributions to the Fund under the Act being deducted from the salary.

Applications, stating age, salary required and full particulars as to qualifications and experience, accompanied by copies of three recent testimonials, must be delivered to the undersigned not later than 10 a.m. on Wednesday, the 2nd October, 1929, and endorsed "Assistant Engineer."

GEO. H. RADDIN, A.M. Inst. C.E.,
Water Engineer and Manager.

Town Hall Chambers,
Ashton-under-Lyne,
18th September, 1929. 3231

Maidstone Waterworks Company.

ENGINEERING ASSISTANT.

APPLICATIONS are INVITED for the POST of ENGINEERING ASSISTANT from qualified candidates between the ages of 26 and 31.

Candidates must hold a Civil Engineering Degree at an English University or the A.M. Inst. C.E. Diploma. Preference will be given to candidates who have had office and field experience in the design and sinking of deep wells and borings; the design and construction of reinforced concrete reservoirs, &c.; the laying of large mains, both steel and cast iron; and in the design, erection and maintenance of modern pumping plant.

The appointment will be for three years in the first instance at a salary £300 per annum.

Applications, stating age, qualifications and experience, together with copies (only) of three recent testimonials, must reach the undersigned on or before Tuesday, October 22nd, 1929. The envelopes should be endorsed "Engineering Assistant."

CHARLES H. HARDEN,
Engineer and Manager.

Pudding-lane, Maidstone,
27th September, 1929. 3253

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, Energetic SALESMAN to Represent makers of High-speed Diesel Engines; must have good experience of the work.—Write to 3289, The Engineer Office, giving fullest particulars of experience and state salary required. 3289 A

WANTED, JUNIOR ENGINEER SALESMAN, with practical and commercial knowledge of Machine and Small Tools. Applicants with experience of the London trade preferred.—Address, in confidence, stating qualification, experience, age and salary, 3264, The Engineer Office. 3264 A

WANTED, TECHNICAL ASSISTANT to Efficiency Engineer. Must have drawing-office experience. Knowledge of time studies on steel works plant and rolling mills an asset, but not essential.—Address, stating age, experience, and salary required, P3278, The Engineer Office. P3278 A

A LONDON FIRM, Makers of Recording Instruments for Boiler-house and Works Control, WANTS TECHNICAL SALES CORRESPONDENT. Must have adequate technical qualifications and experience in dealing with sales correspondence. State age, qualifications and experience in detail, also salary required.—Address, 3260, The Engineer Office. 3260 A

AEROPLANE STRESSING.—SENIOR TECHNICAL ASSISTANT REQUIRED, preferably with experience of R.A.E. methods of stressing.—Apply, A. V. ROE and CO., Ltd., Newton Heath, Manchester. 3256 A

ASSISTANT ENGINEER REQUIRED for Service with Oil Company operating in Venezuela. Single, age 25-30. Candidates should have obtained an Engineering Degree at one of the universities or, having served a regular apprenticeship, supplemented such by obtaining an Engineering Degree or Diploma at one of the recognised training colleges. Must also have had several years' practical experience. Salary 275 dollars (U.S.A. currency) per month. Three years' engagement with first-class passage out and home on completion of agreement, and outfit allowance provided. Selected candidate will be required to be passed as medically fit for tropical service.—Write, stating age and giving in chronological order full particulars of past training and experience, to Z.B. 216, c/o Deacon's Advertising Agency, Fenchurch-avenue, London. 3285 A

ASSISTANT MECHANICAL ENGINEER WANTED for South of Europe, with up-to-date experience in Workshops Management and thorough knowledge of Repair and Upkeep of Railway Rolling Stock and other Heavy Machinery. Knowledge of Spanish desirable.—Write, stating salary required, age, experience, whether married or single, to "E. G. L." c/o Streets, 6, Gracechurch-street, E.C. 3. 3266 A

ASSISTANT CIVIL ENGINEER WANTED for employment abroad, with experience in Railway Maintenance, Construction of Piers, Jetties, &c.—Write, stating salary required, age, whether married or single, to "R. E. P." c/o Streets, 6, Gracechurch-street, E.C. 3. 3267 A

BUYER REQUIRED, Used to Mass Production of Small Parts, familiar with metals and operations. Only keen man with experience considered and must be able to organise his own department.—Address full details, age, experience, salary, 3259, The Engineer Office. 3259 A

CONSTRUCTIONAL STEEL WORK DESIGNER REQUIRED for London Consulting Engineer's Office. Knowledge of Building Act, 1909, necessary. State experience and salary expected.—Address, P6220, The Engineer Office. P6220 A

ARNOLD BOOKS

MINING SUBSIDENCE. By HENRY BRIGGS, D.Sc., Ph.D., M.I.Min.E., Hood Professor of Mining in the University of Edinburgh. viii + 216 pages, 83 illustrations. **14s.** net.

"A masterly and comprehensive survey of the present situation of our knowledge."—*Iron and Coal Trades Review.*

"Because it deals with the subject from all points of view, withal practically, concisely and thoroughly, it should be in the hands of all interested in mining subsidence."—*Engineering.*

MODERN ROADS. By H. PERCY BOULNOIS, M.Inst.C.E., Chairman of the Council of the Roads Improvement Association, etc. xii + 302 pages, 13 plates. **16s.** net.

HYDRAULICS: For Engineers and Engineering Students. By F. C. LEA, D.Sc., M.Inst.C.E., Professor of Mechanical Engineering in the University of Sheffield. FOURTH EDITION. xii + 594 pages, 400 diagrams. **18s.** net.

BRITISH ENGINEERING WAGES. By ROBERT SPICER. **10s. 6d.** net.

"A well-informed and thoughtful enquiry."—*The Economizer.*

STEAM POWER. By W. E. DALBY, F.R.S., M.Inst.C.E., M.I.Min.E., University Professor of Engineering, City and Guilds (Engineering) College. SECOND EDITION. xvi + 760 pages, 250 diagrams. **25s.** net.

PROPERTIES OF STEAM and Thermodynamic Theory of Turbines, including the Callendar Steam Tables. By H. L. CALLENDAR, F.R.S., Professor of Physics, Imperial College of Science and Technology. xii + 532 pages, 36 diagrams. **30s.** net.

THE ENLARGED MOLLIER DIAGRAM for Saturated and Superheated Steam. Drawn by PROFESSOR H. L. CALLENDAR, F.R.S., from the values obtained from his equations for "The Properties of Steam," and printed in three colours on squared paper, 33 × 28 inches. Price **4s.** net (by post in a tube **4s. 9d.**).

FUEL: Solid, Liquid and Gaseous. By J. S. S. BRAME, F.I.C., Professor of Chemistry, Royal Naval College, Greenwich. THIRD EDITION. xvi + 388 pages, 73 diagrams. **18s.** net.

LONDON: EDWARD ARNOLD & CO. 41 & 43, MADDOX ST. W.

SITUATIONS OPEN (continued)

ENGINEER, with First-class Experience of Turbo-generators, REQUIRED for important mine in the Tropics. Must be fully qualified to supervise and keep in good running order the steam and electrical units of a large mining plant. Only men of highest character and first-class ability need apply. Salary £60 per month and all found, with first-class passage out and home. First engagement 12 months. Good opening for an energetic and capable man.—State age and write with full details of training and experience, and enclosing copies of references, to "TURBINE," c/o of W. Vickers and Co., Ltd., 24, Austin Friars, E.C. 2. 3255 A

GERMAN TRANSLATOR REQUIRED. Engineering experience and exceptional command of English indispensable.—SMITH, 113, Kingsway, W.C. 2. P6224 A

LOCAL INSPECTING ENGINEER REQUIRED to undertake occasional Inspections of Machinery and Structural Material in Glasgow.—A. S. LOWE, Consulting Engineer, 73, Lichfield-street, Wolverhampton. P6234 A

MESSRS. NEWTON, CHAMBERS and CO., Ltd., Thorncliffe, near Sheffield, REQUIRE an ASSISTANT MANAGER for their Ironworks Department. Applicants must be thoroughly well educated and with a minimum experience of five years in a responsible position in the works of a large constructional engineering and foundry firm. Age thirty to forty. Must possess initiative, determination, and tact.—Applications, stating salary required, should be addressed to the MANAGING DIRECTOR, and will be regarded as confidential. 3241 A

REQUIRED for London Buildings, ONE or TWO ASSISTANTS, used to setting out Steel Work. Thoroughly accustomed to using instruments. State age, experience, and salary required.—Address, 3244, The Engineer Office. 3244 A

ROAD CONTRACTORS REQUIRE Experienced ENGINEER for Private Street Works in London area. Must be competent estimator and used to taking sole charge of execution of contracts. Salary £500 and commission on profits.—Address, in strictest confidence, 3261, The Engineer Office, stating age, previous experience, qualifications, and enclose copies of recent testimonials. 3261 A

SECOND ENGINEER for Steam-electric Power Station on North-East Coast of South America. Experience with Steam Plant and Alternating Current essential. Married man without children of school age preferred. Salary £50 per month with house.—Address application, with full record of career and references (copies only), 3254, The Engineer Office. 3254 A

TRAVELLER REQUIRED for London Office of Midland firm supplying all kinds of Steel Plate and Structural Work. State remuneration required.—Address, 3272, The Engineer Office. 3272 A

WORKS MANAGER REQUIRED IMMEDIATELY, to take control of 200-hand factory in South of England. Must have had experience in quantity production of Wood and Metal Parts. Must be first-class organiser, firm disciplinarian, used to modern up-to-date factory methods. A good practical knowledge of Petrol Engines and their general installation essential. This is a progressive position and a fine opportunity for an energetic man. Replies should state full experience, salary required, age, and photograph, if possible.—Address, 3277, The Engineer Office. 3277 A

WANTED, ASSISTANT MARINE ENGINEER-DRAUGHTSMAN, used to detail designing of Machinery for Tugs, Fishing Vessels, and small Coasters.—State age, experience, and salary expected, —CRABTREE and CO., Great Yarmouth. 3115 A

WANTED by an Old-established Engineering Firm in Western India, an experienced DRAUGHTSMAN, capable of preparing competitive designs for all classes of Structural Steel Work. Applicants should give full particulars of education, training and subsequent career, with references and state salary expected.—Address, 3263, The Engineer Office. 3263 A

WANTED, DRAUGHTSMAN, in Westminster, Used Concrete Mixers, &c. Give full details previous experience with dates, copies of testimonials, state age, salary, when free.—Address, P6211, The Engineer Office. P6211 A

WANTED, DRAUGHTSMAN, with Experience of Mechanical Equipment of Electric Winders. State particulars of age, experience, and salary.—Address, 3279, The Engineer Office. 3279 A

SITUATIONS OPEN (continued)

WANTED for Cement Machinery Manufacturers, experienced MECHANICAL ENGINEERING DRAUGHTSMEN. Experience in Cement Machinery and Plant an advantage, but not essential.—Address, giving age, salary, and experience, 3204, The Engineer Office. 3204 A

WANTED IMMEDIATELY, a First-class DRAUGHTSMAN; Design of Heavy Machinery and Structural Steelwork; must have good experience and first-class references; London area. State salary required.—Address, 3292, The Engineer Office. 3292 A

WANTED, TWO Qualified MECHANICAL DRAUGHTSMEN, about 24 years old, used to fine accurate work.—Applicants should write, stating experience, age and salary required, to Box 128, Advertising Offices, 84, Queen Victoria-street, London, E.C. 4. 3249 A

BLAST-FURNACE DRAUGHTSMAN.—Large FIRM of Constructional Engineers REQUIRE the SERVICES of a SENIOR DRAUGHTSMAN with experience in Blast-furnace Plant, &c. Age, experience, and salary required.—Address, 3191, The Engineer Office. 3191 A

CAPABLE DRAUGHTSMAN WANTED for Large Iron and Steel Works, Middlesbrough; preferably man having wide experience in Steel Works and Rolling Mill Equipment; permanent position to suitable man.—Address, stating age, experience and salary required, 3294, The Engineer Office. 3294 A

CRANE-BENNETT, Ltd., REQUIRE a First-class DRAUGHTSMAN DESIGNER to take over the installing and economic running of machines on mass production work, tools, jigs, &c. A knowledge of engineering construction, foundry practices, and the French language an advantage. A progressive man with organising ability desired.—Write, stating full particulars, to G. C. DETLEFSEN, 45/51, Leman-street, London, E. 1. 3262 A

DESIGNER DRAUGHTSMAN.—An Opening Occurs in a well-known Engineering Works in the South of England for a DESIGNER DRAUGHTSMAN experienced in the design and development of Air-cooled Petrol Engines. Applicants should write stating precisely their experience, age, and salary expected.—Address, 3252, The Engineer Office. 3252 A

DRAUGHTSMAN-DESIGNER for Engineering Plant Lay-out REQUIRED; man with experience of Structural Steel and Tool Design preferred. A knowledge of French is desirable, and applicant must be willing to work in Paris.—Apply by letter, with full particulars, to G. C. DETLEFSEN, 45/51, Leman-street, London, E. 1. 3262 A

DRAUGHTSMAN.—EASTON and JOHNSON, Ltd., Taunton, have a VACANCY for a fully qualified DRAUGHTSMAN for Steam Engine and General Engineering Work. Only men with good practical experience to apply. State previous experience, age, and salary required. 3288 A

DRAUGHTSMAN, GOOD SENIOR, With Experience of A.C. and D.C. Generators and Motors.—Address, stating age, qualifications, references, and salary required, to 3130, The Engineer Office. 3130 A

DRAUGHTSMAN (MECHANICAL) WANTED for London Office, age 20-25; knowledge of Pipe Work and Electricity an asset; permanency for keen man.—Write, giving full particulars and wages required, 3296, The Engineer Office. 3296 A

DRAUGHTSMAN REQUIRED for Light Mechanical and Clockwork; South London district.—Address, stating age, experience, to 3311, The Engineer Office. 3311 A

DRAUGHTSMAN REQUIRED; One Used to medium structure.—Address, stating age, experience, to 3312, The Engineer Office. 3312 A

DRAUGHTSMAN REQUIRED Immediately, London. Must be used to Furnace Design and Gas Producer Work. Excellent prospects for right man. State age, experience and salary required.—Address, 3317, The Engineer Office. 3317 A

DRAUGHTSMEN REQUIRED in the Newcastle-on-Tyne district, having sound working knowledge of Materials Handling Plant. Must have experience in detail and design of modern plant. State salary and give details of experience.—Address, 3202, The Engineer Office. 3202 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN REQUIRED With Experience in the Design of Light Locomotives. State age, experience and salary required.—Address, 3230, The Engineer Office. 3230 A

DRAUGHTSMAN WANTED for South of Spain. Must be all-round man used to General Steel Work and Mechanical Detailing. Knowledge of Mining Plant Machinery an advantage. Unfurnished quarters provided. Single man preferred and must be not less than 25 years of age. Salary £300 to £350 a year, according to qualifications.—Write, "S. D.," c/o Streets, 6, Gracechurch-street, E.C. 3. 3267 A

DRAUGHTSMAN WANTED, with Sound Technical training. Preferably experienced in Condensers, Evaporators, and Power Station Auxiliary Plant. London district.—Address, stating age, experience, and salary required, P6219, The Engineer Office. P6219 A

DRAUGHTSMAN WANTED With Experience in the Design of Road Making Machinery, Road Rollers, &c. State age, experience, and salary required.—Address, 3229, The Engineer Office 3229 A

DRAUGHTSMAN WANTED with First-class Experience in Estimating and Design of Materials Handling Plant; must be fully qualified in Design of Light Structures.—Write, stating age, experience, salary required and when free, to Conveyor Department, Messrs. STOTHERT and PITT, Ltd., Engineers, Bath. 3293 A

DRAUGHTSMEN.—The BRITISH THOMSON-HOUSTON CO., Ltd., Rugby, has VACANCIES for SENIOR DRAUGHTSMEN with good Steam Turbine or Motor and Electrical Apparatus experience.—Applications, stating age, experience, and salary required and references, to MANAGER, Drawing-offices, B.T.H. Co., Ltd., Rugby. 3193 A

EXPERIENCED DESIGNING ENGINEER REQUIRED by Electrical Manufacturing Company; must have wide experience of large Alternating-current Generators. State age, experience and salary required.—Address, 3295, The Engineer Office. 3295 A

EXPERIENCED DRAUGHTSMAN WANTED, with thorough knowledge of Fan Design and Application.—Apply, stating age, experience and salary required, to MANAGING DIRECTOR, MUSGRAVE and CO., Ltd., St. Ann's Ironworks, Belfast. 3287 A

EXPERIENCED GENERAL DRAUGHTSMEN REQUIRED for temporary positions, accustomed to Surveying, Levelling, Preparing Plans and Estimates for Permanent Way, &c.

Apply by letter to E. H. d'E. DARBY, Divisional Engineer's Office, L.M. and S. Ry., Derby, stating age, experience, and salary required. P6214 A

EXPERIENCED MECHANICAL DRAUGHTSMAN, about 30, well up in calculations; also smart JUNIOR, about 24. Give full particulars.—Address, 3206, The Engineer Office. 3206 A

EXPERIENCED STEEL WORK DRAUGHTSMEN REQUIRED for temporary positions, accustomed to the designing of Girder Work and other Constructional Work, Measuring Up existing Railway Bridges, Calculation of Stresses, &c.—Apply by letter to E. H. d'E. DARBY, Divisional Engineer's Office, L.M. and S. Ry., Derby, stating age, experience, qualifications, and salary required. P6213 A

JIG DRAUGHTSMEN.—SEVERAL Really First-class MEN REQUIRED. Experience in Jigging Internal Combustion Engines a recommendation.—Apply, stating age, experience and salary required, to the BRISTOL AEROPLANE COMPANY, Ltd., Aero Engine Department, Filton House, Bristol. 3257 A

MACHINE TOOL DRAUGHTSMEN.

JOHN HETHERINGTON and SONS, Limited, have SEVERAL VACANCIES and invite applications from men with good all-round experience of high-class Heavy Machine Tool Work; must be capable and efficient designers; ability the first consideration. —ANCOATS WORKS, MANCHESTER. 3270 A

JUNIOR DRAUGHTSMAN, with Experience in Lay-out and Details of Dust Collecting and Ventilating Plant. Good prospects for quick, accurate and neat worker.—Address, P6215, The Engineer Office. P6215 A

REQUIRED for British-owned Railway in Argentina, TWO DRAUGHTSMEN, with thorough knowledge of Calculations and Design of Bridge Abutments and Retaining Walls in Brickwork and Armoured Concrete. Must have sound knowledge of design and armoured concrete railway structures and be capable of preparing working drawings and quantities. Salary on 3 years' agreement £400, rising to £500 p.a. Free passages.—Write, stating age, if single or married, full details training and experience, with copies (only) of testimonials, to Box A.E. 2, c/o Davies and Co., 95, Bishopsgate, London, E.C. 2. 3283 A

REQUIRED for Engineering Works in Ceylon, an ENGINEER DRAUGHTSMAN, to Take Charge of Drawing-office, experienced in Structural and Mechanical Work and Estimating. Preference given to one with shops experience, age about 25. Salary according to qualifications.—Apply in writing to REKLAW, 3, London Wall-buildings, London, E.C. 2. 3246 A

SENIOR AIRCRAFT DRAUGHTSMEN.—Four WANTED IMMEDIATELY for London District. Applicants must state all details of experience and salary required.—Write, Box No. 1319, Shaw and Blake, Ltd., 8, Bell-yard, Temple Bar, London, W.C. 2, Advertising Agents. 3315 A

STRUCTURAL DRAUGHTSMAN REQUIRED, capable of designing Light or Heavy Steel Work in connection with Materials Handling Plants and Coal Screening and Washing Plants. District, Newcastle-on-Tyne. State salary required and give full details of past experience.—Address, 3201, The Engineer Office. 3201 A

STRUCTURAL DRAUGHTSMAN WANTED by a Firm of Calcutta Structural Engineers, required for light and heavy work. Must have knowledge estimating. Unmarried. Age about 25. Salary commencing Rs. 500 per month; 5 years' agreement. —Apply in writing, with full details of experience, to Z.E. 88, c/o Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 3286 A

TANGYES LIMITED Require the Services of a fully qualified and experienced DESIGNER as CHIEF of the OIL ENGINE DESIGN DEPARTMENT. Applicants should write fully and state age and salary.—Address, Managing Director, Tangyes Limited, Birmingham. Applications will be treated in confidence. 3291 A

TOOL DRAUGHTSMAN REQUIRED for Press Tools and Fixtures for Small Repetition Work.—Write, stating experience and salary required, to G. K. H., 150, Western-avenue, North Acton, W. 3. 3265 A

TWO JUNIOR DRAUGHTSMEN REQUIRED, with general mechanical and light structural experience; also THREE with experience in Conveyors and Elevators. Progressive positions with good prospects.—Apply, stating age, experience, when at liberty, and salary desired, to HERBERT MORRIS, Limited, Department 39, Loughborough. 3281 A

PATTERNMAKERS (ENGINEERS), Permanency.—Apply, PERCY J. SMITH, 2a, Wynyatt-street, London, E.C. 1. 3187 A

For continuation of Small Advertisements see page 4.

A Seven-Day Journal

L.M.S. Improvements Programme.

THE first detailed announcement by a British railway company of the programme of work which it proposes to undertake as an outcome of the abolition of the railway passenger duty in the last Finance Bill was made this week by the London, Midland and Scottish. The total sum to be expended is £2,250,000 and represents the capitalised value of the duty which has been remitted. A sum of £450,000 is to be expended on the construction of fifty-five new locomotives, of which thirty are to be of the Garratt type. A sum of like magnitude is to be devoted to the carrying out of improvements at the Camden Town, Birmingham and Stoke-on-Trent goods terminal accommodation and to increasing the coal shipping plant at Garston, Grangemouth, Ayr, Troon, and Swansea. For the strengthening of bridges a sum of £200,000 has been set aside, and a like amount has been earmarked for the conversion of gas-lit coaches to electric lighting. Other items in the programme include £140,000 for the provision of additional running line facilities to obviate the delay caused to fast passenger traffic by goods shunting operations, £110,000 for additional traffic sheds and siding accommodation at Goole Docks, and £63,000 for improving the passenger accommodation at various stations. The whole of the programme has received the sanction of the Ministry of Transport.

Coal and Oil Firing on Ships.

AN official memorandum has been issued to surveyors by the Mercantile Marine Department of the Board of Trade regarding the simultaneous use of coal and oil as fuel on board ship. The practice of using coal and oil either simultaneously or alternatively on a passenger ship, although not definitely prohibited, is strongly deprecated. The memorandum instances two recent fires on ships which were using coal and oil simultaneously, the "Carmarthenshire," which took fire in the Thames, and the "Trojanstar," which met with mishap off the Pacific Coast of North America. The case of the "Trojanstar" is probably more illuminating than that of the "Carmarthenshire." The vessel left port as a coal burner, and was being converted to oil burning at sea when a pipe joint failed, and caused a spray of oil to be directed on to the front of a coal-fired boiler, a furnace door of which happened to be open at the time. A fierce fire was started, which resulted in the loss of one life, and which, but for the gallant action of a fireman, would almost certainly have led to the abandonment of the ship. The Board has now instructed its surveyors not to grant passenger certificates to steamers in which it is intended to burn coal and oil in a common stokehold unless adequate provision is made for isolating the oil fuel boiler space from the coal fuel boiler space, and the full fire appliance equipment required for an oil-burning vessel is also provided. If pulverised coal and oil are burned simultaneously, the risk of fire, it is admitted, is less than with ordinary coal and oil, but it is held to be greater than if oil only is used. Modified requirements are laid down to meet this case. Cargo vessels are also dealt with in the memorandum. The dual system of firing, and especially the practice of conversion at sea, are to be held as rendering a vessel unseaworthy, unless precautions are taken, to render the risk of fire remote, to limit its extent by division of the boiler-room, and to extinguish it by the provision of adequate fire appliances.

Shipyard Wages.

THE Shipbuilding Employers' Federation met the executive and district representatives of the Amalgamated Society of Woodworkers in Carlisle on Monday last, when the employers made a definite offer to apply the proposed uniform wages scheme for time workers to all members of the Society in federated shipyards, provided that normal relationships were restored in all federated districts. It is hoped that a basis of a settlement of all outstanding questions between the Federation and the Society may thereby be found. The Federation is consulting its members in other districts with regard to overtime and other matters which have been under discussion. In the case of the joiners' strike at Belfast, it has been announced that the employers and the union have agreed that the claim should be referred to arbitration, and the question is to be immediately submitted to a meeting of the strikers.

Foreign Trade.

THE old and inexhaustible question of the help which a Government should give to manufacturers in their attempt to secure foreign orders has been raised once more by a letter which the National Union of Manufacturers has just addressed to Mr. Arthur Henderson, Secretary of State for Foreign Affairs. The letter records that on September 17th the Union had under discussion the question whether an adequate degree of assistance is being given by the Government to British manufacturers who are seeking to obtain competitive foreign orders. At this meeting the view was expressed that the help given by the Government to British firms is not as active and resourceful as that rendered by other Governments to their own nationals. The members of the Union thought that the position would be improved if in matters connected with overseas trade they could have direct access to an experienced trade branch situated in the Foreign Office itself. The Administrative Council of the Union feels, says the letter, that the Foreign Office, ambassadors and other Government representatives abroad might take a more active part in promoting British trade interests, and make greater efforts to secure orders in foreign countries. It thinks that it would be helpful if a special department were set up in the Foreign Office to deal entirely with trade matters.

Rationalisation.

THE meeting of the Inter-Parliamentary Commercial Conference in Berlin on Monday last was preceded by a committee meeting at which the rationalisation of industry was discussed, Mr. P. J. Hannon, M.P., opening the debate with a paper in which the following points were developed in favour of horizontal combination. (1) Scientific allocation of capital in accordance with which adequate provision will be made where it is most essential and where the margin of earning capacity is greatest. (2) The duplication of waste in each department of the combine will be reduced to a minimum and the maintenance of large stocks of commodities, which, in the ups and downs of trade, accumulate in small industries, will be kept at the lowest economic level. In the ideal combine capital will never be locked up unprofitably, but will be employed when and where its proportionate contribution to the success of the whole aggregation will be most effective. (3) The prevention of overlapping in the great variety of research and investigation activities which attach to every branch of modern industry. (4) Fluctuations in prices of goods will be kept within reasonable limits to the advantage alike of the manufacturer and the consuming public. (5) The highest economic results from the balanced relationship of capital and labour in great enterprises will be secured. (6) The greater combination is in itself an assurance against those risks which must be contemplated from season to season by small competing industries. After the discussion, Mr. Hannon submitted a resolution that the question of national and international rationalisation should be carefully examined, and that the delegates to the next Conference should report the result of these inquiries.

Port and Starboard.

UNDER the recently concluded Convention on Safety of Life at Sea, it was agreed that after midnight on June 30th, 1931, helm or steering orders are to be given in the direct sense, that is to say, when a ship is going ahead and an order containing the word "starboard" or "right" is given to the steersman, it is to be interpreted as meaning that the wheel, the rudder-blade and the head of the ship shall all move to the right. The Court of the Honourable Company of Master Mariners has been considering this regulation, and in an announcement issued this week has characterised it as prescribing a change comparable in magnitude with that which would be implied by a reversal of the rule of the road from left to right in the case of land traffic. It will, it states, mean the uprooting of the practice of centuries, meaning no doubt the practice followed for centuries by British seamen. To British seamen, although not to the seamen of all other countries, a helm order containing the word starboard means that the tiller is to be put to starboard and therefore that the ship is to turn towards port. To the seamen of some other countries the order means that the vessel is to be turned towards starboard by moving the tiller to port. The precise direction in which the steersman is to turn the wheel depends at present not only on the interpretation of the order but on the design of the connection between the wheel and the rudder head. Under the new regulation uniformity is to be secured among the ships of all the contracting Governments in the sense that a helm order containing the word starboard or right is to mean that the wheel is to move to the right, that such a movement shall cause the rudder to move to the right, and that as a consequence the ship's head shall turn to the right. The Honourable Company of Master Mariners appears to accept the change as inevitable, but is opposed strongly to the substitution of "right" and "left" for "starboard" and "port." It suggests that after the date named helm orders should be issued as "steer starboard" or "steer port" until such time as the change becomes familiar, when the words "steer" might be omitted.

Railwaymen's Wages.

ON Tuesday last the discussion between the railway companies and certain unions on the subject of wages was opened. It lasted for a couple of hours and then stood adjourned to enable the unions to consider the case put before them by the companies. In a statement issued after the meeting, the announcement was made that the National Union of Railwaymen, the Railway Clerks' Association, and the craft unions were represented, but that the Associated Society of Locomotive Engineers and Firemen was not. No date was definitely fixed for a further meeting. We need not remind our readers that the discussion has arisen out of the 2½ per cent. voluntary reduction of wages which was agreed to by the men, the directors also agreeing to a 2½ per cent. reduction of their fees, just about a year ago. This agreement was terminable by a three months' notice after the expiration of one year; the railway unions gave that notice in August, and it will become effective in November unless, on further consideration, the unions withdraw it. If they persist, the companies will probably make a formal claim for a reduction of wages. It is understood that Sir Ralph Wedgwood told the unions on Tuesday that the companies were not in a position to restore the 2½ per cent. at the present time. The attitude of the Locomotive Engineers and Firemen is causing some complication. That Associated Society at present refuses to discuss the question at all until the 2½ per cent. has been restored. It may depart from this attitude after its meeting on October 7th.

The White Star Liner Oceanic.

IT is announced by the White Star Line that it has been decided to suspend work on the new 60,000-ton Atlantic liner "Oceanic," which was laid down at Belfast last year, and to give priority to the construction of a new motor vessel of about 27,000 tons, a sister ship of the "Britannic," already launched. It is intended to allow the keel plate of the "Oceanic" to remain undisturbed on its slip until such time as several important problems connected with the propulsion of the vessel have been discussed and solved. Lord Kylsant, the chairman of the White Star Line, some time ago stated that the vessel would be driven electrically, but apparently no decision has yet been reached as to whether the prime movers shall be steam turbines or oil engines.

Sea Communication between Sweden and England.

WITHIN the last few days we have received an abridgement of a Report regarding the best means of improving the communication by sea between Sweden and England. The Report was prepared at the command of the Swedish Government by the Board of Administration of the Swedish State Railways, and the abridgement is, as are so many Swedish commercial documents nowadays, in excellent English. Its particular interest lies in the fact that it discusses a proposal to institute a train ferry service between Gothenburg and Immingham. It is pointed out that with two vessels having a sea speed of 16½ knots it would be possible to provide for three sailings a week in each direction. The time spent at sea would be 31½ hours. It is anticipated that, with a passenger traffic of 21,000 per annum, realising £88,000, and with goods traffic bringing in from £116,000 to £126,000, or a total of from £204,000 to £214,000 per annum—these figures being on a conservative basis and likely to be exceeded—the service would be a paying undertaking, since the cost of running and maintenance, together with interest on capital and amortisation, is estimated at £192,000. If, however, a third vessel, to act as a standby, were to be employed, the proposed service would not be remunerative, but with a third vessel in commission it would be possible to provide five round trips per week in both directions, instead of three, without any considerable increase in expenditure. It is proposed that the vessels should be 445ft. long, 64ft. broad, and have a draught of from 24ft. to 25ft., with a displacement of 9100 tons. The machinery would comprise turbines capable of developing 7200 shaft horse-power. The boats would have accommodation for 200 first-class and 100 third-class passengers. Passenger trains would not be carried on the vessels, the whole of the space being given up to goods wagons. The maximum effective weight of cargo which it is proposed should be carried would be from 850 tons to 900 tons.

The Ebbw Vale Iron and Steel Co.

ON Wednesday evening of this week Sir Frederick Mills announced that all the men and officials at the Ebbw Vale works would receive notice to-morrow, Saturday. Between 3000 and 4000 people are affected. The return of severe foreign competition within the past month or six weeks was the reason given by Sir Frederick for the step which his company proposed taking. Unless something was done quickly the whole works, he said, would come to a stop. He appealed to the Government to disregard everything that had happened in the past, and to strike out into fresh fields for itself. Foreign competitors had suddenly dropped their prices, and, without exception, customers were refusing to pay home prices when they could buy from abroad at cheaper rates. Materials which we should be making in this country were being made abroad under conditions which he would not ask his workmen to accept. Those foreign-made materials had, however, taken the place of British commodities in the markets of the world.

Tilbury Docks Improvement Works.

THE new entrance to the Tilbury Docks was officially opened yesterday, September 26th, by Lady Ritchie, of Dundee, on board the Orient Steam Navigation Company's ss. "Oronsay." We described in our issue of July 13th, 1928, the works then in progress in connection with the improvements which the Port of London Authority had been engaged upon since 1925 at the Tilbury, West India, and Millwall docks. We are now able to give some fuller particulars of the dock works at Tilbury, including the new lock and the dry dock, together with several views of the completed works in the Supplement and on page 323. The floating landing stage in the river at Tilbury, which, although practically completed, was not included in the scope of yesterday's opening ceremony, but will be put into service early next year.

In our earlier article will be found fairly full particulars of the plant and methods of construction employed by the general contractors, Sir Robert McAlpine and Sons, in carrying out the Tilbury works, and on the present occasion we propose to describe more particularly the finished works.

The new entrance has been provided so that the Port of London shall have adequate facilities in the lower reaches of the river for vessels of larger dimensions than can be accommodated at the previously existing lock at the Tilbury Docks, the effective length and width of which are 700ft. and 80ft. respectively. The other works embraced in the docks improvement scheme include :—

(*a*) A new dry dock, 750ft. long internally, 110ft. wide at the entrance and having 37ft. 6in. depth of water over the blocks and over the sill. This dry dock has been so constructed that it can be readily extended when necessary, without interference with its use, to a total length of 1000ft.

(*b*) The diversion of the railways for goods and passenger traffic to the south side of the main dock and the provision of road access thereto ; and

(*c*) The provision of an additional 800 lineal feet of quayage in the main dock and the increase of the water area of the dock by 15 acres.

COST OF WORKS.

The approximate cost of these works, including the entrance lock, is £2,550,000. The Port Authority has received financial aid towards the cost of the improvements from H.M. Government through the Unemployment Grants Committee in the form of a grant of half the interest charges for fifteen years on the capital expenditure involved.

ENTRANCE LOCK.

The lock—Fig. 4—is 1000ft. long between gates, 110ft. wide at the entrance and has a depth of water on all the sills of 45ft. 6in. at Trinity High Water.* The overall length of the lock is 1300ft., and it is capable of accommodating the largest vessel afloat. It is situated about 1200ft. westward of Tilbury Ness at the western end of the dock system, and is aligned in the direction of the strongest prevailing winds. The maximum rate of the tidal stream at the approach jetties is about 3 knots. There are three sets of gates dividing the lock into two portions, 700ft. and 300ft. in length respectively, and at the river end there is a reverse sill with hollow quoins and anchorages for the reception of the outer pair of gates should it be necessary at any time to de-water the lock. These gates are made so that they can be lifted and reversed to fit against the outer sill pointing towards the river.

The gates are of the semi-buoyant type without rollers or roller paths. The design of gates without rollers and paths, now quite a usual practice, is, however, a new departure on the part of the engineers of the Port of London Authority. The gates are of mild steel construction with greenheart heel posts, mitre posts and clapping sills. The gate framing is polygonal in plan, the water-pressure side of the gate forming three flat faces and is not curved. The construction is clearly shown in the view Fig. 5, of some of the gates in course of erection in the contractors' works. The gate-opening machines—Fig. 6—are direct-acting hydraulic rams, 18in. diameter, the connecting-rod being coupled direct to the steel framing girders of the gate. The "crocodile" beam, which was formerly often employed in such situations, is dispensed with, the gate framing being specially stiffened vertically and horizontally at the point of connection. The normal hydraulic pressure employed for these rams, as for other hydraulic machinery at the dock, is 750 lb. per square inch. The gates and the hydraulic machinery therefor, have been constructed by Vickers-Armstrongs, Ltd.

Emptying and filling culverts and sluicing culverts are provided in the lock walls and there are no sluices in the gates. The culverts are arranged to discharge and intake on either side of each pair of gates. The openings are exceptionally numerous, and are arranged so as to be effective in scouring the gate recesses, sills and chamber floors. The penstocks are operated by hydraulic rams and all have greenheart paddles. The lock can be filled or emptied in ten minutes at the normal difference of working levels.

A rolling-lift bridge provides access for road and railway across the river end of the lock. This bridge is seen in several of the views in the Supplement. The bridge is electrically operated, both halves being controlled from the same cabin.

At the river end of the lock are concrete return walls, set back behind the old river frontage line, and open-piled timber jetties on either side which form a funnel-shaped entrance channel for vessels. The jetties are so aligned that the channel between them points a little upstream. The northern or upstream jetty is 550ft. long and the downstream jetty 410ft. The jetty construction was carried out, without any temporary staging, by means of a special machine, consisting of a 10-ton steam travelling crane with long jib, framed with overhanging cantilever carrying boilers and piling frames, and driving simultaneously

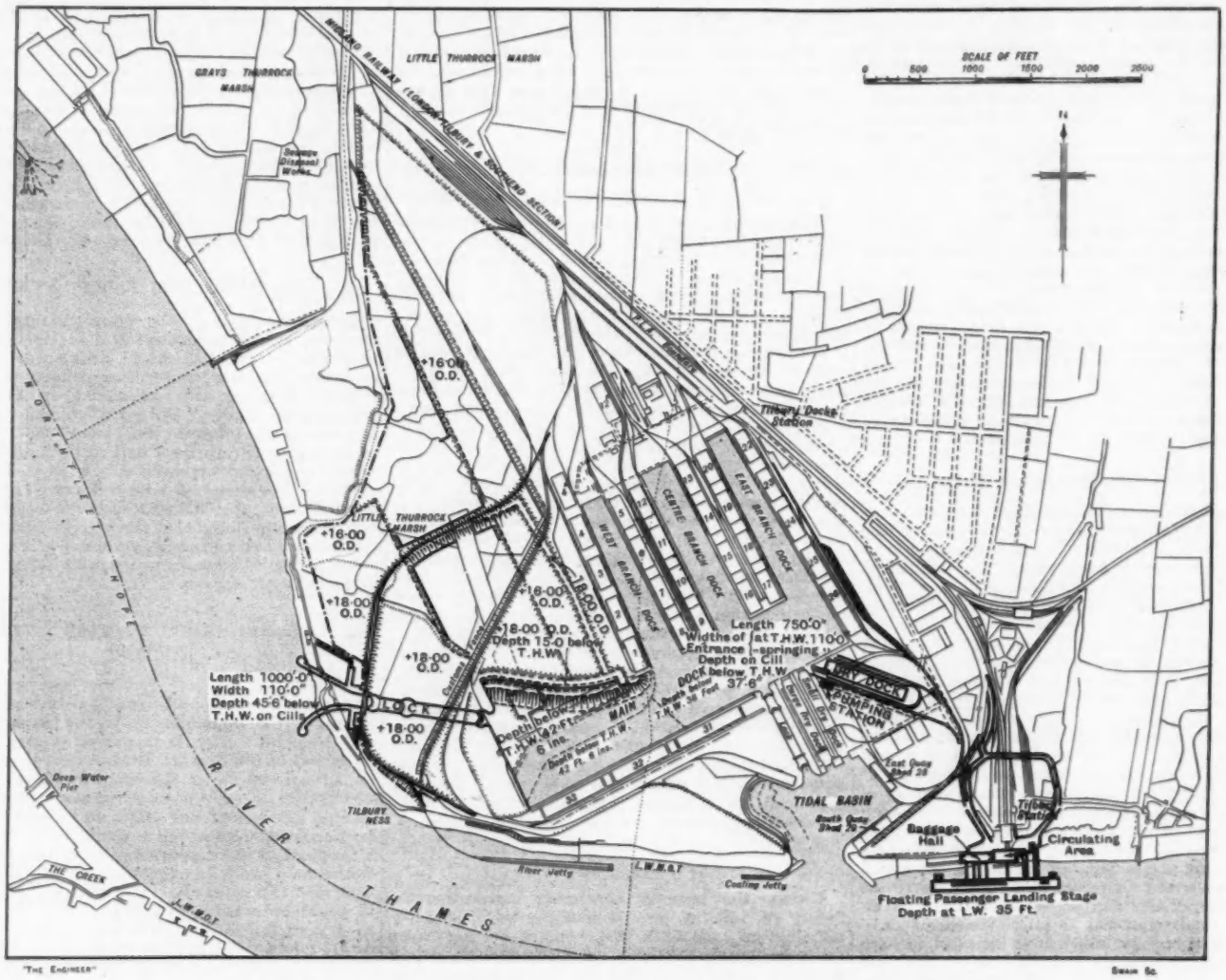


FIG. 1—PLAN OF TILBURY DOCKS SHOWING POSITIONS OF NEW LOCK AND DRY DOCK

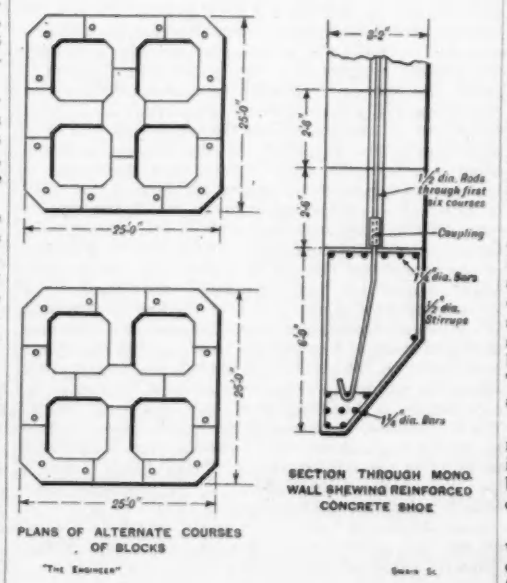
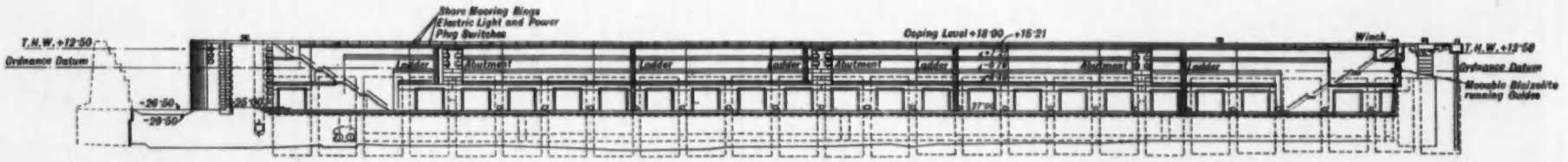


FIG. 2—ARRANGEMENT OF BLOCKS IN MONOLITHS

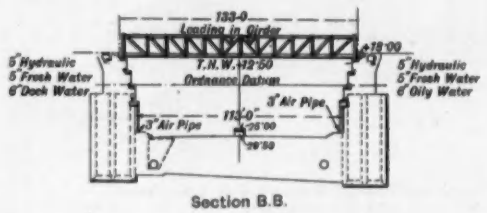
* T.H.W. is 12·5ft. above Ordnance Datum. It is 1ft. above M.H.W.S.T. at Tilbury. The impounded water level in the dock is 11·5ft. above O.D.

TILBURY DOCKS—NEW DRY DOCK

MR. FREDERICK PALMER, C.I.E., P.P. INST. C.E., WESTMINSTER, CONSULTING ENGINEER



Longitudinal Section



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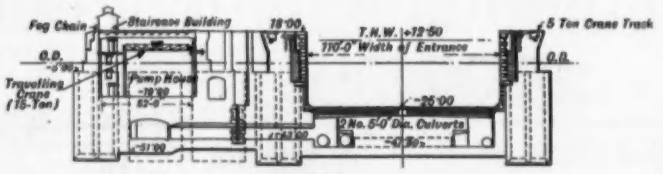

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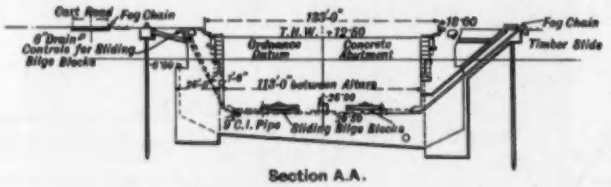
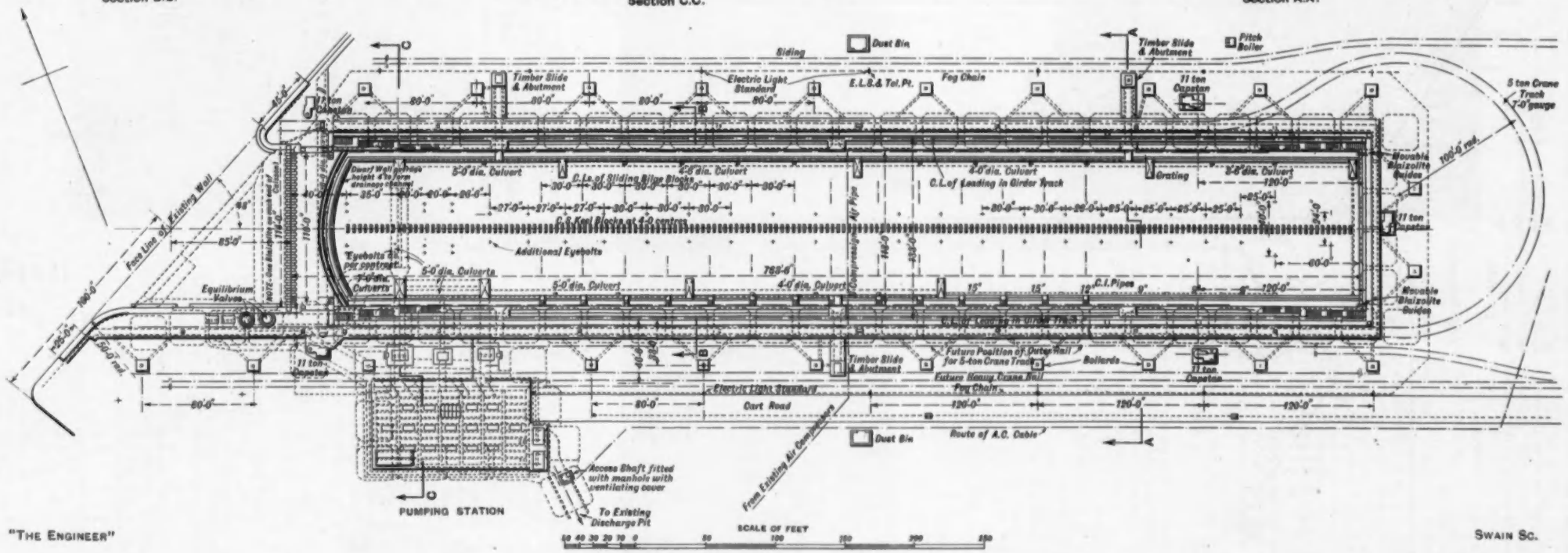


Section A.A.



"THE ENGINEER" SWAIN SC.

FIG. 3—PLAN AND SECTIONS

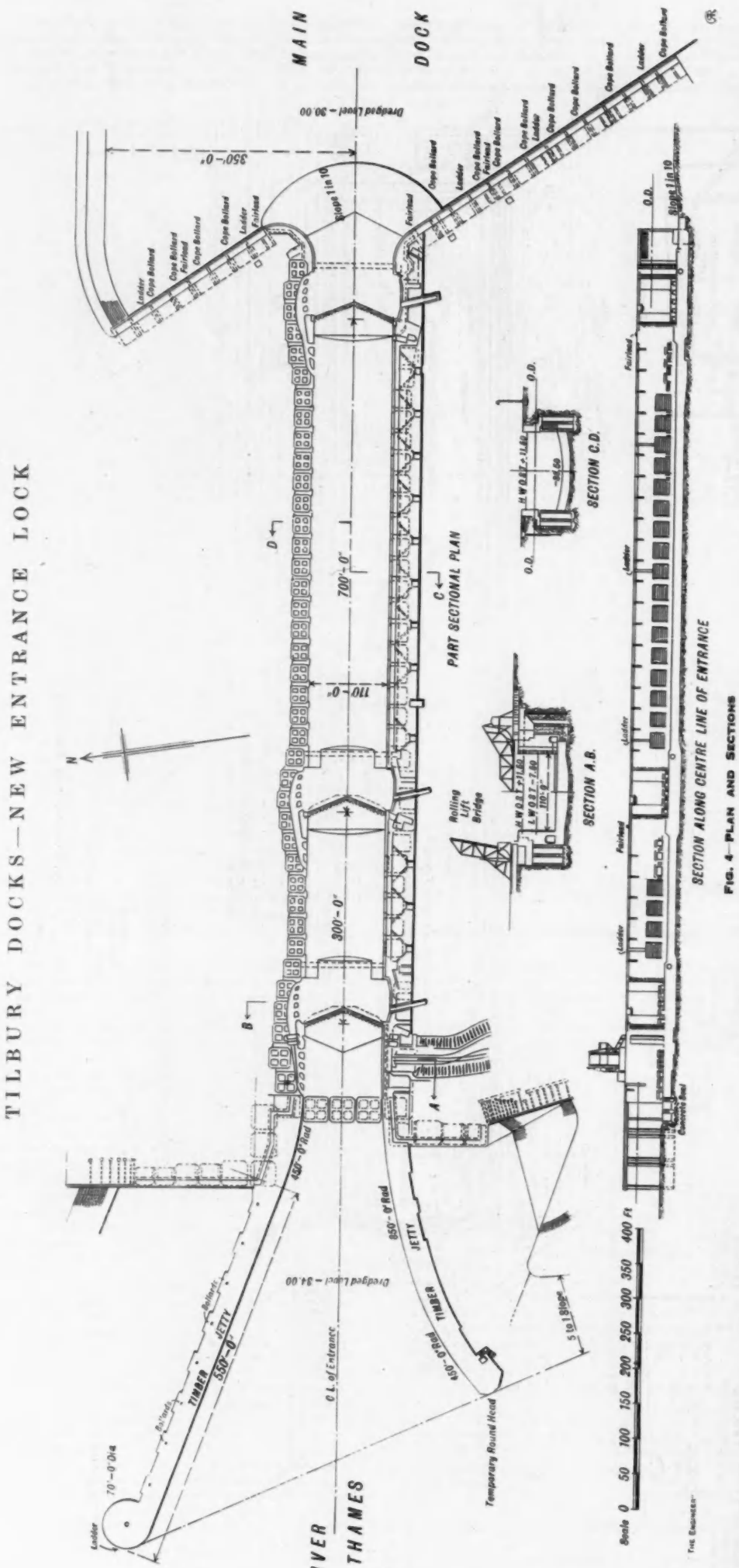


FIG. 4—PLAN AND SECTIONS

the three piles of which each frame of the jetty consists.

The ground formation on the sites of the lock and dry dock is of marsh clay. To obtain a firm foundation for the walls it was necessary to reach the gravel strata and at some places the chalk beneath the gravel. These formations are covered by the marsh clay or mud, locally known as "bungum," with some layers of peat, to an average depth of 44ft. below O.D. in the case of the lock. The gravel is generally at a lower level at the site of the dry dock and the maximum depth of the foundation is 70ft. below quay level. For the greater part the marsh clay was overlaid with made-up ground or deposits of refuse.

Monolith construction was adopted for the whole of the lock walls and for the walls of the dry dock, which we describe later. The ground was excavated to a depth of 5ft. below O.D. by steam navvies and dragline excavators, preparatory to sinking the monoliths, in order to reduce the pressure behind the latter until the invert was put in, and to enable the dimensions of the monoliths to be kept within reasonable limits. The monoliths are, generally, 25ft. square, but there are some 30ft. and 35ft. square for special purposes. The average height of a monolith is 49ft., but in a few cases it is 65ft. The number at the entrance lock is 120. The line of monoliths which forms the lower part of the return walls at the river entrance is carried across the entrance to form a deep toe wall for the apron. The three monoliths, each 35ft. square, which were sunk in the entrance, were built up above the apron level to serve as a temporary safety dam behind the natural dam formed by the old river bank. The concrete monolith blocks, which would be at levels above the apron when sinking was finished, were set in lime mortar so as to be easily removed on completion of the work.

The walls above the monoliths are of mass concrete, as is also the lock invert. The concrete blocks of which the monoliths are built, both in the lock and dry dock, are about 7 tons in weight—Fig. 2. The building and grabbing from the four wells in each monolith were carried out in all cases by 15-ton derrick cranes, twenty-three in number, mounted on bogies and travelling parallel with the walls. These cranes were all set between the walls and on the excavated level of 5ft. below O.D., and, after the sinking was completed, were used for sealing and hearting the wells with concrete. The monoliths were sunk in such order as to allow the dumpling at each end to be removed while the monolith sinking in the middle of the site was still proceeding, and at that stage drainage sumps had to be provided to prevent the water rising from the underlying gravel. The inverts were afterwards proceeded with, in sections enclosed by steel sheet piling, the sectional method being adopted in order to minimise the pumping. By these arrangements, monolith sinking, dumpling excavation, invert trenching and invert concreting were carried out simultaneously in various parts of the works.

It may be noted in passing that the reinforced concrete shoes of the monoliths—Fig. 2—were not provided for in the original designs. The original intention was to employ structural steel shoes, but the delay caused by the coal strike in the supply of the material resulted in the adoption of the reinforced concrete design, which proved satisfactory in every way.

In some cases no less than 2264 tons of cast iron kentledge—mostly in the form of squared blocks about 7 tons weight—had to be used to overcome skin friction and to sink the monoliths to the gravel bed.

The fendering of the lock walls is provided for by suspending built-up horizontal fenders from the coping. Each fender consists of a baulk timber core laid with lengths of coir rope placed horizontally, the whole being bound together by a circumferential wrapping of rope. Each fender is hung by three wire ropes.

THE DRY DOCK.

The new dry dock—see page 321 and Supplement—occupies the south-east corner of the main dock, its entrance being from the wet dock on the east side of the old dry docks. The wall at the inner end is of a semi-permanent character, and has been constructed to admit of extending the length to 1000ft., when required. The dock is closed by a floating caisson, a view of which is given in the Supplement. The pump house is below quay level close to the south wall, and an impounding culvert extends from the pump house to the tidal basin. This culvert is also connected to the old pump house, so that the two previously-existing dry docks can be dewatered by the new pumps. The pumping plant consists of centrifugal pumps, electrically driven. Those for dewatering have a capacity of 24,000 cubic feet per minute, and the pumps for impounding have a combined capacity of 34,000 cubic feet per minute. There are also the usual charging and drainage pumps. The sub-contractor for the pumping plant was Worthington-Simpson, Ltd.

The dry dock walls are founded on seventy-one concrete monoliths, similar to those used in the entrance lock, and the same sequence of operations was followed. The invert was constructed in sections enclosed by steel sheet piling. Three rows of sections form the full width of invert, the middle row being first taken out, in alternate sections, and the rows adjoining the side walls excavated and concreted afterwards. The invert is carried down everywhere to

the ballast, and is thus thicker in places than is necessary, considering it solely as an inverted arch. The lower part of the concrete in the invert, which serves in a sense as filling, is a mixture containing comparatively little cement.

The dry dock is exceptionally interesting on account of certain novel features of its equipment, notably the "leading-in" girder, which spans the dock chamber, and the hydraulic bilge blocks. The former is a contrivance designed to keep the stem of a ship entering or leaving the dock in correct position on the centre line. It consists of a light steel lattice girder, a view of which is given in the Supplement. This girder or bridge, which is strongly braced and stiffened horizontally, is mounted on a wheeled carriage at each end. The wheels are spaced wide apart, and travel on rails laid on the top altar courses. Horizontal side rollers are also provided. In the middle of the girder is the centreing frame with which the ship's stem engages and to which it is locked. On the girder is mounted a 60 H.P. petrol motor, which drives, by means of geared shafting, the travelling wheels at the two ends. The girder can thus travel along the dock hauling or pushing the ship as the case may be, or, alternatively, the vessel can push or pull the "leading-in" girder, which in that case merely keeps the bow on the centre line of the dock.

Mechanical bilge-blocks, usually operated by chains and wedges, have been employed in dry docks for some years past, but we believe the use of hydraulic blocks adopted for the Tilbury dry dock constitutes a new departure. The construction of the blocks will be readily understood from the engraving Fig. 7. In operation a horizontal hydraulic ram which is situated beneath the hinged bilge girder in each block pulls in or pushes out a large roller. The horizontal motion of this roller raises or lowers the block girder. The hydraulic supply pipes are laid transversely across the dock floor in covered conduits, and are carried up the dock walls to operating valves situated near the coping level. Each bilge block is operated by an individual valve. The adjustment of the blocks can therefore be performed as soon as the ship's keel comes in contact with the keel-blocks during the course of de-watering the dock. There are twenty-eight of these bilge blocks, fourteen on each side, and they were made by Henry Berry and Co., Ltd., of Hunslet, Leeds.

The keel-blocks are of cast steel with greenheart cappings. The faces of the steel taper sections are machined. An extensive series of experiments to determine the best angle of taper, to insure the easy release of the blocks when unkeyed, was carried out at the National Physical Laboratory. The ingenious devices for keying-up the blocks and securing groups of them to the dock floor can be seen in Fig. 7 and in one of the views in the Supplement.

The equipment of power and other services available at the dry dock is very complete. Compressed air can be tapped at numerous points on air mains placed at the foot of the side walls of the dock. Fresh water, river water and hydraulic valves and connections as well as connections for electric current are placed in recesses under the coping at intervals on both sides of the dock, and powerful flood-lights are fitted in the dock walls and on the inner face of the caisson. We note that timber slides are provided, although these contrivances are more often than not omitted in modern commercial dry dock construction.

The capstans placed around the dock are all hydraulically operated, and have been made by Carrick and Wardale, Ltd., Several are of 11 tons capacity.

FIG. 5—LOCK GATES UNDER CONSTRUCTION

FIG. 7—HYDRAULIC BILGE BLOCKS

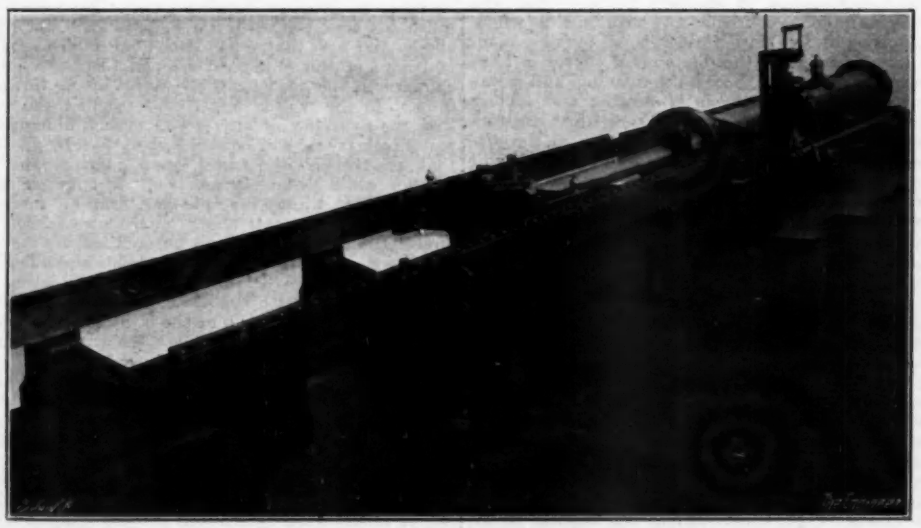


FIG. 6—18IN. HYDRAULIC GATE MACHINE

GENERAL.

The contract for the lock and dry dock was given to the contractors—Sir R. McAlpine and Sons—in September, 1926, and these works were to be completed in four and three years respectively. A large part of the works has actually been finished approximately twelve months before the scheduled time. Among the sub-contractors for important items of equipment, in addition to those already mentioned, are Sir William Arrol and Co., Ltd.—"leading in" gear; Glenfield and Kennedy, Ltd.—sluices and penstocks; and Swan, Hunter and Wigham-Richardson, Ltd.—caisson.

The whole of the Tilbury Docks improvements have been designed and executed under the direction of the Port Authority's consulting engineer, Mr. Frederick Palmer, C.I.E., to whom we are indebted for permission to make use of drawings and photographs and for the information upon which our account has been based.

The Port Authority's engineer for new works is Mr. F. W. Davis, and the resident engineer at Tilbury, Mr. W. Mackenzie. The contractors principal agent on the works was Mr. McKenzie.

HITSORY OF TILBURY DOCKS.

The Tilbury Docks are situated 26 miles below London Bridge, and were constructed by the East and West India Dock Company, being formally opened on April 17th, 1886. Originally the system comprised a main dock with three branch docks and an open tidal basin, the total water area being 74 acres. The original entrance dock is 700ft. long, 80ft. wide, and 38ft. deep on the inner sill, and two graving docks were provided. The system was equipped with twenty-four transit sheds, each 300ft. long by 120ft. wide and with railway lines and transit facilities.

The designers had looked well ahead of the requirements of their day, as is evidenced by the fact that the accommodation sufficed to meet the needs of shipping for nearly forty years. In 1917 the Port Authority extended the main dock by 1450ft. to provide more berths for vessels and increased the total water area to 90 acres. Additional transit sheds have been erected from time to time.

PORT IMPROVEMENTS GENERALLY.

The total cost of the improvement works carried out by the Port Authority and completed shortly after the war amounted to £11,000,000.

Other large works in progress in the Port at the present time are:—

Tilbury Passenger Landing Stage.

Modernisation of the West India and Millwall Dock system.

New entrance to the West India Dock—opened September 5th, 1929.

Development of the Lavender and Acorn Ponds—Surrey Commercial Docks—embracing new discharging berths, timber storage sheds, impounding station, &c.

The estimated cost of these works, together with the Tilbury improvement scheme, is £4,709,000.

The Institute of Metals.

THE autumn meeting of the Institute of Metals was held at Düsseldorf from September 9th to 12th last and was attended by upwards of 275 members and ladies—a far larger gathering than had been attracted by any previous autumn meeting of the Institute. The general very marked success of the meeting amply justified the undertaking. As usual, the formal opening of the sessions of the Institute was preceded, on the afternoon of September 9th,

by the autumn lecture of the Institute. On this occasion the lecture was delivered, in excellent German, by Dr. A. G. C. Gwyer, who dealt on very broad and popular lines with "Aluminium and Its Alloys." This lecture was held in the large hall of one of the Düsseldorf schools and attracted a large audience, which included many prominent German metallurgists who remained in Düsseldorf after the immediately preceding meeting of the Deutsche Gesellschaft für Metallkunde. The text of this lecture has already appeared in the issues of THE ENGINEER for September 13th and 20th.

The formal meetings of the Institute opened at 9.30 a.m. on Tuesday, September 10th, in the meeting hall of the Verein Deutscher Eisenhüttenleute, which had been kindly lent for the purpose. This proved to be an almost ideal meeting room, every possible facility being available. The only shortcoming was, perhaps, that from the British point of view the artificial ventilation appeared somewhat inadequate, but this may have been due to the very hot weather.

The President of the Institute, Dr. W. Rosenhain, F.R.S., opened the meeting by welcoming the attendance of so large a number of non-British members of the Institute, addressing words of welcome to the German and the French members in their respective languages. Professor Dr. O. Bauer, as Chairman of the Deutsche Gesellschaft für Metallkunde, then spoke in English, welcoming the visit of the Institute to Düsseldorf on behalf of himself and his colleagues in the German Society at whose invitation the meeting had been arranged. The meeting was then addressed by Mr. Keith Jepson, H.M. Consul-General at Cologne, who had come there at the request of H.M. Foreign Office and H.M. Ambassador at Berlin to express the good wishes of H.M. Government for the success of the meeting and to lend it any support in its power. In this connection it may be mentioned —although it did not arise at this stage of the proceedings—that the German Government had also given its very friendly support to the meeting and had granted special Customs facilities to the members of the Institute on entering Germany.

The President next announced that, in order to mark the occasion of the first visit of the Institute to Germany, the Council had decided to elect Professor G. Tammann to the honorary membership of the Institute. He pointed out, in a brief speech in German addressed to Professor Tammann, who was present, that up to that moment the short list of the honorary members of the Institute included only one non-British name, that of Henri Le Chatelier. Professor Tammann responded in German in terms which showed a deep appreciation of the international recognition which had thus been accorded to him. While these proceedings unavoidably curtailed the time available for the reading and discussion of the numerous papers on the programme, they undeniably struck a note of international friendship and co-operation which re-echoed throughout the whole meeting and to some extent through the German Press generally. It was especially notable that in this feeling were included not only the British and German metallurgists, but the representatives of the metallurgy of some eighteen other nations, among whom the French were particularly notable, owing to their participation in the reading of papers and in discussion in their own language; in this they were encouraged by the fact that the President also made use of French from time to time.

The first paper to be taken dealt with "Some Methods of Research in Physical Metallurgy," and was presented by Dr. Rosenhain (President) in the form of a paper, rather than as an address, in order to furnish the opening for a general discussion. The paper consisted of a comparatively brief summary of the many special methods of research and the instruments for carrying them out, which have been devised during more than twenty years at the National Physical Laboratory by Dr. Rosenhain and his collaborators. Many of these are well known, but a concise summary is useful. Attention was drawn to the more novel features contained in the paper, relating to a "bubble" method for securing black-body conditions for the optical pyrometry of metals at very high temperatures, and to a new form of electrical recording dilatometer which has been devised by the President and Mr. W. E. Prytherch.

The next paper, by Dr. Masing, of Berlin, was presented, at the request of the Council of the Institute, with the purpose of indicating the German view in regard to methods of metallographic research. Dr. Masing devoted his paper to a discussion of the principles which underlie this type of research, confining himself to the problem of the accurate determination of equilibrium diagrams and emphasising the supreme importance and the inviolability of the Phase Rule. An animated discussion, which is likely to be actively continued in writing, then took place, Professors Hanson, Desch, Turner and Thompson, and Sir Henry Fowler taking part. Professor Desch drew attention to the fact that the method of measuring small displacements by changes in the capacity of a small condenser which had been adopted in the dilatometer described by the President had been used by others for such measurements as the minute strains in metal test pieces, while a device for measuring the changes of volume on freezing and melting had been worked out and used with great success in his laboratory by Dr. Smith, to whose work reference was made by the President. Professor Hanson said that he had long been acquainted with the majority of the methods described in the President's paper and could bear testimony to their value. Professor Turner was glad to see that the changes of length and volume during solidification and cooling, to which he had devoted much time some years ago, were now receiving so much attention. Professor F. C. Thompson, while agreeing that the most accurate and highly skilled work was required for the purpose of establishing the true equilibrium diagrams of alloy systems, suggested that it was also necessary to study the alloys in their metastable condition, since it was always in that condition that they occurred in practice; he suggested that the study of alloys under conditions in which no attempt was made to attain equilibrium was easier and required less skill and less special apparatus than the more fundamental kind of research. In winding up the discussion and asking Dr. Masing to make his reply in writing, the President suggested that it would probably be found that the study of alloys in a metastable state was at least as difficult as work on equilibrium conditions, since everything would depend upon securing accurately reproducible conditions and on knowing just how far the alloys in each case were away from equilibrium. With regard to Dr. Masing's devotion to the Phase Rule, he thought it well to remember that the Second Law of thermodynamics was the expression of a wide general experience rather than a law quantitatively deducible from experimental measurements, and that it could only stand so long as no exceptions to it were encountered. When an alloy apparently failed to obey the Phase Rule—which was a deduction from the Second Law—it was nothing more than an assumption to say that the alloy must be out of equilibrium and that it would, if given sufficient time, attain a state compatible with the Phase Rule. In very many cases this appeared to be true, but the inference could be pushed too far. Further, it had recently been suggested that there are—in solid crystals—degrees of freedom related to shear stresses, of which the classical form of the Phase Rule took no note. He thought, therefore, that, while seeming exceptions to the Phase Rule should not be taken lightly, it was still undesirable to re-draw diagrams, away from experimental evidence, on Phase-Rule grounds alone.

The group of papers next considered related to dilatometry, Monsieur Chevenard presenting, in French, an account of the paper by himself and Messieurs Portevin and Wache on "A Dilatometric Study of Some Univariant Two-phase Reactions," while Dr. M. Haas presented a paper by himself and a Japanese collaborator, Dr. Denzo Uno, on "An Improved Differential Dilatometer." The paper by the French authors described the application of the well-known Chevenard differential dilatometer to the study of transformations occurring in the solid state in certain aluminium alloys of the age-hardening type and in a group of iron-copper-nickel alloys. The authors show clearly how these transformations, and especially the deposition of a disperse phase from a supersaturated solid solution, can be followed on the dilatometer curves. Dr. Haas and his collaborator have worked out an improved form of photographically recording dilatometer, utilising the arrangements due to Chevenard, but effecting marked improvements, mainly of a mechanical nature. Perhaps the most important—as Monsieur Chevenard pointed out in the very friendly discussion—is the use in Dr. Haas' instrument of a magnetising coil and iron armature for securing the small contact pressure which is needed in order to keep the measuring head of the dilatometer in uniform contact with the specimens under measurement. The discussion, which was opened by Dr. Marie Gayler, turned mainly upon the interpretation of the dilatometer curves in relation to the dispersion theory of hardening, and it was pointed out that the cycle of heating and cooling temperatures employed by the French investigators would not allow of complete re-solution of the disperse phase at the high-temperature end, but would lead to coagulation and softening, so that the anomalous nature of some of the curves could not be regarded as surprising.

A brief account was then given by Dr. W. H. J. Vernon of the paper prepared by him and Mr. L. Whitby on "The Open Air Corrosion and Surface Patina of Copper." In this paper it is pointed out that in the specimens of copper, both modern and old, examined by the authors, the green patina was found to be due to the presence of basic sulphates or—near the sea and away from towns—of basic chlorides. The view expressed in the literature of the subject that the green patina of ancient copper was due to basic carbonates was described as an error, due probably to unsatisfactory methods of analysis. In the subsequent brief discussion, Dr. U. R. Evans contended that the facts as stated in the literature were correct for truly ancient specimens, whose patina had been formed at a time when the use of sulphurous coal had not been known—he could not believe that the analyses were at fault to such an extent.

The meeting adjourned at 12.30, the President having previously announced the names of the candidates proposed by the Council for election as officers and Council of the Institute for 1930–31. The President-designate is Dr. Richard Seligman, Ph.D., of London.

On September 11th the first paper presented was that by Dr. Rohn on "Reduction of Shrinkage Cavities and Vacuum Melting." It described some remarkable results achieved at the Heraeus Works in electric melting in vacuo, followed by very slow pouring into a water-cooled mould. The author pointed out that the formation of shrinkage cavities was due to the contraction during freezing occurring in a mould containing a large mass of liquid metal. If the liquid metal were only poured into the mould at the same rate as that at which solidification occurs, so that there was never more than a thin layer of liquid present in the mould at any one time, no cavities could be formed. Very slow filling of a mould, however, was not feasible in the presence of air, since the thin stream of molten metal would be too seriously oxidised. The paper showed that vacuum melting and casting has now attained a considerable scale of industrial development. In the discussion, Dr. R. S. Hutton drew attention to the way in which Dr. Rohn's paper showed the remarkable possibilities of translating what seemed to be purely laboratory methods to the works scale in a highly successful manner—an achievement of which Dr. Rohn and his firm had every right to be proud. The President supported this view, and pointed out that as long as fifteen years ago he had stated the principle of slow filling of a mould as the only way of avoiding shrinkage cavities. He was glad to see it finding practical application at last.

The next paper was that by Mr. M. Tama on "New Methods for Melting Non-ferrous Metals in the Electric Furnace," which gives a further description of the electric furnace practice at the well-known "Hirsch Kupfer u. Messing Werke," near Berlin. The author gives further details of the new electric furnaces which have been adopted and of the further progress made in these works towards the aim of complete electrification. The full information given in this paper, together with the invitation which had been extended to members of the Institute to visit the works themselves, were much appreciated, and another animated discussion on the use of electric heat in the working of non-ferrous metals followed, in which Dr. Brownsdon, Dr. Hutton, Mr. Frank, Mr. F. D. Campbell, Mr. Archer (U.S.A.), Mr. Smout, and Mr. Spittle took part. One of the principal points discussed was the size of melting unit which could or should be used. Where very long rod or strip is required, large ingots have to be produced, and some manufacturers therefore desire a large melting unit. On the other hand, such a large unit can only be emptied in a somewhat long time, and this is inconvenient where electric heating is used. The question of furnace linings was also raised, and special reference made to Rohn's method of sintering a lining *in situ* by forming it on a mould made of the same material—alloy—as was subsequently to be melted in the furnace. The mould thus constitutes the first charge of the furnace, and serves to put the lining into satisfactory condition. In the course of a brief reply, Mr. Tama mentioned that lining difficulties had been largely overcome. Linings were now made largely of previously-shaped blocks, and had given a life of as much as 2000 heats.

Dr. N. F. Budgen then presented his paper on "Pinholes in Aluminium Alloy Castings," which summarised and discussed from the foundry point of view, the factors which affect the occurrence of these defects and the various methods of prevention, including the "pre-solidification" method of Archbutt, Rosenhain's method of blowing an inert gas—nitrogen—through the molten metal, and Tullis' use of chlorine for the same purpose. In the discussion, Mr. Mundey suggested that there had been much less trouble with the older and "simpler" alloys, and also that much depended upon the skill and care of the foundry workman. Mr. Archbutt emphasised the need for the removal of gas already present in the molten metal, and recalled the fact that the solubility of nitrogen in molten aluminium and its alloys was particularly low, so that, by passing that gas through the metal, other gases present in solution could be largely removed. Mr. Archer suggested that while the pre-solidification method advocated by Archbutt might prove slow and costly, almost the same effect could be obtained by merely pouring the metal into large pig moulds and allowing it to solidify there before re-melting and casting it. Dr. Haas agreed with the use of nitrogen as a practically inert gas, stating that the injurious gases were hydrogen and carbon monoxide. He attached much importance to Tullis's method of using chlorine, and pointed out that, if carried out in a reasonable manner, this process could not be regarded as dangerous.

The next paper taken was that by Dr. O. F. Hudson, Mr. T. M. Herbert, Mr. F. E. Ball, and Mr. E. H. Bucknall, on "Properties of Locomotive Fire-box Stays and Plates." This paper is the first published report of the work of a group of investigators who, under the British Non-Ferrous Metals Research Association, have been engaged on a lengthy investigation of the fire-box stay problem. These investigations, both in the laboratory and on the locomotive, have led the authors to the conclusion that the failure of stays is due to wastage or erosion of the stay heads brought about by slight leakage of water from the boiler. This leakage is, in turn, ascribed to slight plastic yielding of the material of the stays, which gradually loses its power of exerting elastic pressure

on the holes into which the stays have been fitted. The solution of the problem would thus appear to lie in finding a material which, while closely resembling copper in other respects, such as ease of riveting into place, would retain its elastic properties at the temperature of the fire-box walls. The authors show that the addition of a very small amount of silver to the copper raises the elastic limit at these temperatures considerably so that the material thus produced should be suitable for meeting the peculiar conditions of the fire-box stay. The discussion showed a high degree of appreciation of the value of the work done, not only from the railway point of view, but also because the fundamental facts brought out in regard to the properties of copper were of importance to manufacturers and users in many other directions. Sir Henry Fowler, who had been associated with this investigation from its beginning, expressed the thanks of the British railways to the Research Association and the investigators, and also paid a tribute to the friendly co-operation which they had received from the German railways, which were faced with very similar problems. A brief account of the German view was given—in German—by Herr Tross, who said that they had first attributed leakage around stay heads to inexact fitting, but had found that no amount of accuracy of workmanship could overcome the trouble. They had encountered the same difficulty with steel fire-boxes and stay bolts and had only overcome it by the introduction of 5 per cent. of nickel.

The last paper to be presented was one by Messrs. Zeerleder and Bourgeois on "Effect of Temperatures Attained in Overhead Electric Transmission Cables." This paper dealt largely with the use for overhead cables of an aluminium alloy known as "Aldrey," which is capable of age-hardening in such a manner that, while its tensile strength is very considerably increased, the electrical conductivity is relatively little impaired. The remaining papers on the list, whose authors were not present at the meeting, were taken as read, and the meeting concluded with a vote of thanks to all those concerned with entertaining the Institute at Düsseldorf. This vote was proposed by the President and seconded by Dr. R. Seligman, President-designate, and carried with more than usual heartiness.

The formal proceedings of the Institute, of which a brief account has been given above, constituted only a part of the autumn meeting, both works visits and social functions being amply provided. The visits on the afternoons of the first three days included one to the very fine Foundry Trade Exhibition, the remarkable and extensive research laboratory for iron and steels known as the "Kaiser Wilhelm's Institut für Eisenforschung," under the direction of Professor Körber, and a number of works, including the non-ferrous metals foundry of Messrs. Schwietzke, the rolling mill works of Messrs. A. Schmitz, and the steel works of August-Thyssen Hütte, while, slightly further afield at Duisburg, the works of Demag A.G. and of Messrs. Berg-Heckmann-Selve were visited. Finally, on Thursday, September 12th, a whole-day visit was paid to the great plant of Messrs. Krupp at Essen, where members were shown the newly completed large basic open-hearth steel plant with tilting furnaces and the largest forging press in the world, among many other things. The ladies of the party were meanwhile shown the workmen's settlements and welfare arrangements. The whole party was entertained to luncheon, and a visit was then paid to the extensive research laboratories of the firm.

At the conclusion of the visit to Essen the members of the Institute with their respective ladies split up into three parties; one of these returned to England the same evening; the second spent two days on a visit to Holland, while the third continued the journey to Berlin, and on the following day visited the Hirsch Kupfer and Messing works and on the next day—Saturday—the research laboratories of the Siemens-Schuckert works near Berlin, and then the State Materials Testing Station and the Kaiser-Wilhelm's Institut für Metallforschung at Dahlem. Those who were present at the visit to Hirsch-Kupfer were particularly impressed, not only with the modernity and efficiency of the whole plant, but also with the courtesy and frankness with which every detail of the processes employed was shown and explained. The visits to the research laboratories showed the immense importance which German industry attaches to the vigorous prosecution of research and the readiness with which its results are absorbed and utilised by industry.

The social functions which marked the visit of the Institute of Metals included a dinner and dance given to the members of the Institute and many of their German hosts by the city of Düsseldorf, and a cabaret and dance arranged on behalf of the Institute, at which many of the German hosts were the guests of the Institute. On both occasions speeches strongly emphasising the desire and need for friendly co-operation between the nations, especially in regard to metallurgical science, were made from both the German and the British side. This feeling was so strongly marked and was so obviously shared by the representatives of other nations that informal steps were taken to secure practical results from this exchange of views. In this, as in every other way, therefore, the Düsseldorf meeting of the Institute of Metals may be regarded as one of the most successful in the history of the Institute.

The Shipping, Engineering and Machinery Exhibition at Olympia.

No. III.*

Henry Pels and Co., Ltd.

A selection of punching and shearing machines, all characterised by the fact that the frames, instead of being of cast iron, are built up of high tensile steel plates, is shown by Henry Pels and Co., Ltd., Osnaburgh-street, London, N.W. 1. One of the machines exhibited is the combined plate splitting shears and punch—illustrated in Fig. 76, page 332. In addition to the punch on the left and the plate shears on the right this machine is fitted with blades for cropping round and square bars and for cropping angles and tees either with a square cut or at a bevel up to 45 deg. In addition, by means of special blades, it can deal with joists, channels, bulb angles and other sections. Further, it is equipped with blades for cutting notches, square or triangular in shape, in the webs or flanges of joists, channels, angles and tees. In its largest size it can operate on plates up to ⅝in. thick, and can crop rounds up to 2¼in. in diameter. This size of machine is driven by a 6 horse-power motor mounted on the platform shown to the left of the fly-wheel. To facilitate the movement of plates while they are being sheared, a horizontal channel is formed in the side of the frame, and the ledge of this channel is provided with rollers. The shears and cropping blades are fitted with holding down clamps which can be adjusted by means of hand wheels.

The open-ended shears—illustrated in Fig. 50—are designed for the cold shearing of bars and billets. They can also be supplied to deal with hot material,

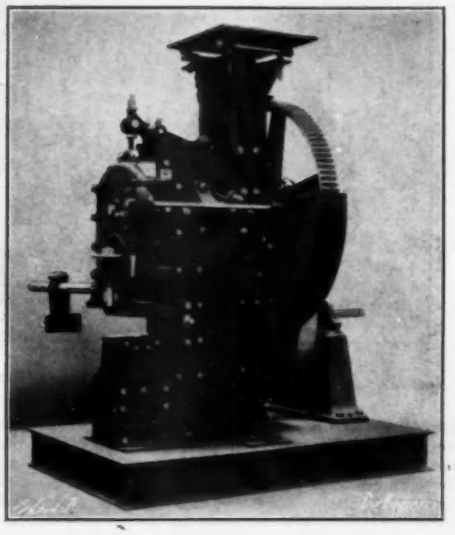


Fig. 50—Bar and Billet Shears—Pels

and, when fitted with special blades, for shearing angles and tees. The actual example of this design of machine exhibited at Olympia can shear squares up to 2in. and proportionate sizes of rounds and flats. The machine is driven through a 7½ horse-power motor mounted on the overhead platform, shown in our engraving, the transmission being made through a belt on to a fly-wheel pulley. This pulley is connected to its shaft through a coupling plate and safety pin. Should the machine be overloaded the coupling plate shears off the pin and interrupts the drive before any damage can be done to the gear wheels and other vital parts. The total net weight of the machine is 73 cwt., and is sufficiently light to enable the machine to be mounted on a truck for the purpose of making it portable. When so mounted the motor driving the machine can be arranged to transmit power to the truck wheels.

The heavy duty billet and slab shears—shown in Fig. 77, page 332—can deal with squares up to 4½in. at a speed of thirteen strokes per minute. It may, however, be fitted with duplex gearing, giving a speed of 25 strokes a minute, at which rate it can shear squares up to 2¾in. The motor is of 22 horse-power, and, as in the case of the other machines illustrated, is mounted on an adjustable overhead platform. Power is transmitted through double gearing to the excentric shaft, which actuates the slide through a plunger. A claw clutch on the excentric shaft is employed to start and stop the motion of the slide. At the top of each stroke the clutch disengages automatically, and a band friction brake comes into action to bring the slide to rest in its highest position. A hand or treadle motion is employed to re-engage the clutch. If required the clutch disengaging gear can be locked so as to give the slide continuous movement. A holding down slide adjusted by a hand wheel and a roller feed bar to facilitate the feeding of the material into the machine are mounted on a cast steel frame on the side of the body. This frame incidentally serves to strengthen the jaws. The shearing slide and the fly-wheel are balanced, and a safety shearing pin is provided in the fly-wheel coupling plate.

* No. II. appeared Sept. 20th.

Batteries, Ltd.

"Nife" steel plate accumulators suitable for many classes of service are exhibited by Batteries, Ltd., of Hunt End Works, Redditch. The general construction of these accumulators—see Fig. 51—is well understood, but we are told that with a view to reducing the internal resistance of the cells and maintaining

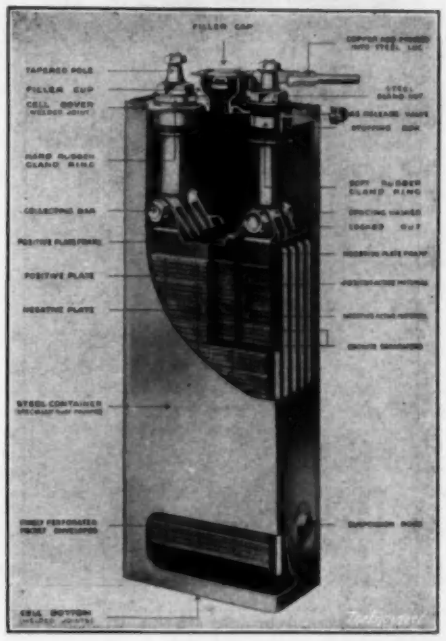


Fig. 51—"Nife" Accumulator—Batteries, Ltd.

the voltage, even under heavy discharge conditions, a corrugated strip is now inserted into the pockets of the active material of the plates. It is well known that as the plates are of steel and the electrolyte consists of a non-corrosive alkaline solution, long periods of idleness do not adversely affect these accumulators. Moreover, they are not damaged by overcharging. All "Nife" accumulators are guaranteed for a period of six years. An interesting exhibit is a "Nife" battery for operating emergency steering gear on oil-engined ships, the cells being of the low resistance type in order that they may deal with heavy currents when the rudder is "hard over." An exceptionally large space is also provided for the electrolyte in order to minimise "topping up." A complete range of marine lighting batteries is shown, either for use as main lighting installations or to serve as a standby for lighting in the event of engine-room failures. Batteries designed to withstand severe vibration and suitable for use on locomotives or electric trucks are on view. There are cells suitable for automatic sub-station work and for switch-closing in connection with the "grid" scheme, and batteries suitable for wireless work in connection with emergency lifeboat sets. For the latter duty the cells are enclosed in weatherproof boxes, and the cell containers are treated by a special cadmiumising process which prevents rust. Headlamps supplied with current from "Nife" batteries are to be seen on the stand, including gasproof lamps for use on oil tankers. There are also portable searchlights and signalling lamps.

Joseph Stubbs, Ltd.

Two patterns of outboard motor for small boats are being exhibited by Joseph Stubbs, Ltd., of Mill-street Works, Ancoats, Manchester. These two motors are much the same in general design, but are intended to run at different speeds. One is known as the standard model and the other as the speed model. They give respectively 16 and 20 horse-power, and are illustrated in Fig. 52.

The engine illustrated is of the two-stroke, two-cylinder, horizontal, opposed type, with a vertical crank shaft. The cylinders are 71 mm. in bore by 63 mm. stroke, and are provided with aluminium alloy pistons. The crank shaft is of what might be described as the motor cycle type, with roller bearings on the pins and large balls for the main bearings. The crank case is of copper-aluminium alloy. The casing which envelops the driving shaft and carries the propeller is also of an alloy which is resistant to the corrosive effects of sea water. Bevel gearing is used to transmit the drive from the vertical shaft to the propeller shaft. Incidentally, this gear

reduces the speed of the engine to one more suitable for the propeller. The underwater parts are free to swing with respect to the power unit, so that the propeller can be used for steering, and an articulation is provided to accommodate the different angles of boat transoms. A special pump is provided for supplying cooling water to the engine.

In the case of the speed model, the engine runs at a speed of from 3000 to 5000 revolutions per minute,

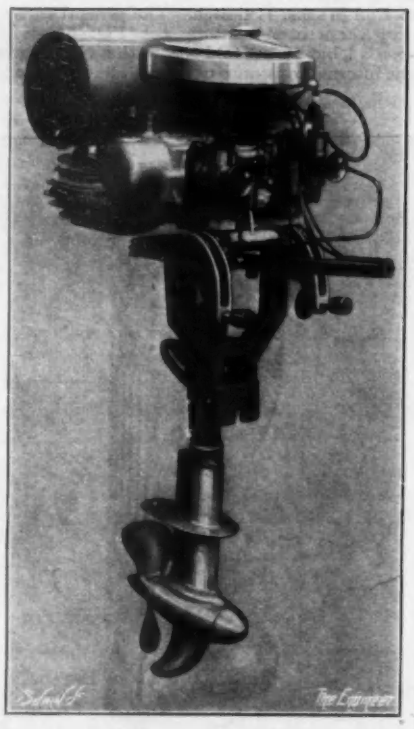


FIG. 52—OUTBOARD MOTOR—STUBBS

and it is equipped with two independent carburetters, each mounted directly upon its respective cylinder. One of these carburetters is tuned for cruising and the other to add to and make the combination suitable for full-power racing conditions. Each carburetter may, nevertheless, be used separately or in combination, as may be desired. By this arrangement the speed model can be effectively used for cruising purposes.

BERNARD HOLLAND AND CO.

ONE of the larger exhibits on the stand of Bernard Holland and Co., of 17, Victoria-street, Westminster, S.W. 1, is the portable heavy oil engine driven air compressing plant, shown in Fig. 53 herewith. The

FIG. 53—PORTABLE OIL-ENGINE DRIVEN AIR COMPRESSOR—HOLLAND

set is designed to supply air to four paving breakers, and it has been built to use heavy fuel oil. At the same time the chassis has been so arranged that it can be towed behind a motor vehicle at a speed of 20 miles per hour. The engine which is to be seen to the left of our engraving is a MacLaren-Benz four-cylinder airless injection heavy oil motor, with an output of 48 B.H.P. at a speed of 980 r.p.m. It is complete with a water circulating pump and a lubricating oil pump, and is fitted with a close speed

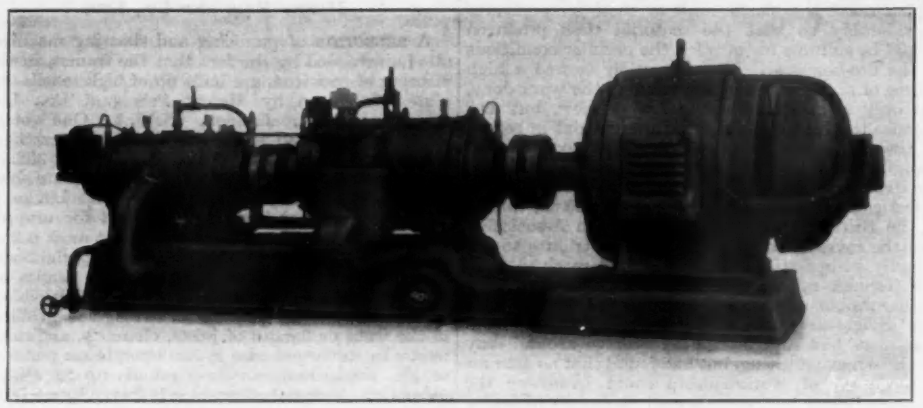


FIG. 54—TWO-STAGE ROTARY COMPRESSOR—HOLLAND

governor operating between the ranges of 250 to 980 r.p.m. The auxiliaries include a fuel service tank and filter, and an exhaust silencer. The air compressor is of the Holland/S L M two stage rotary type, with an intermediate cooler. It is connected to the engine through a Hardy universal coupling and its rated output at 980 r.p.m. is 174 cubic feet of free air at 100 lb. per square inch. In this particular unit a gear-box is interposed between the engine and the compressor, but in other sizes of the same type of machine a direct drive is employed. The compressor operates on the cellular or crescent system, in which there is a rotor fitted with multiple blades set excentrically in the stator or casing. The crescent-shaped space between the rotor and the stator is divided by the blades into cells, which expand from a minimum to a maximum cubic capacity during the suction period, and decrease to a minimum cubic capacity during the compression or delivery period.

Two floating rings are placed towards either end of the rotor, revolve with it, and take the centrifugal thrust of the blades, thereby reducing the friction and rubbing velocity and adding to the smooth running qualities.

The special full lock chassis is worthy of note. It

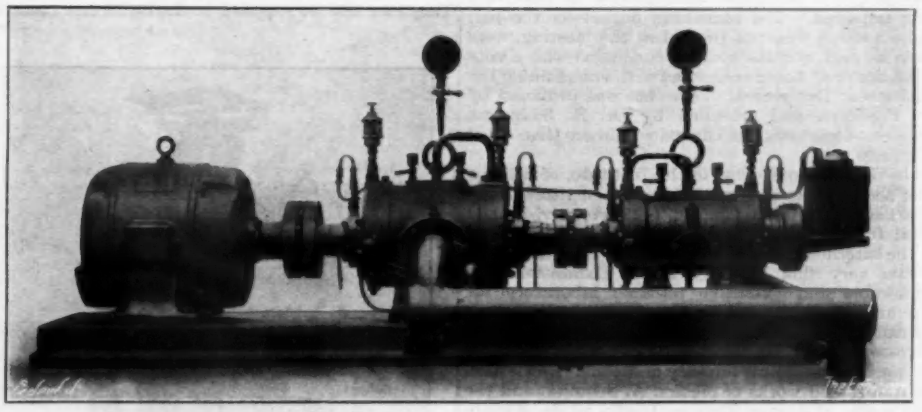


FIG. 55—TWO-STAGE ROTARY VACUUM PUMP—HOLLAND

has a length of 11ft. 3½in., and is 3ft. 9in. wide, and is built up of channel section rolled steel, 5in. deep by 2½in. wide. All joints are electrically welded, thereby making a light and robust structure. The forecarriage seen to the right of Fig. 53 is cross-braced, and is also built up of channels and welded. A patented form of shock-absorbing drawbar is fitted, and the chassis is sprung on semi-elliptical springs, both in the front and the rear. The wheels are of the steel disc type, with a 20in. rim fitting, and are furnished with 24in. by 3½in. Dunlop solid tires. Efficient braking is provided.

Two other exhibits, as shown in Figs. 54 and 55, are a two-stage rotary water-cooled compressor, electrically driven, and a two-stage rotary vacuum pump. This latter exhibit is shown running and is adjusted to give a vacuum of 99·9 per cent. A vacuum of 99·97 has been attained with similar pumps, and in this particular instance a special method of showing the level of the mercury in the "U" tube by means of light is used. The vacuum pump is designed to run at 2850 r.p.m. and requires 1·8 B.H.P. Its designed displacement is 28·2 cubic feet per minute, and its suction capacity 24 cubic feet at a 90 per cent. vacuum.

The two-stage rotary compressor illustrated in Fig. 54 has a running speed of 2850 r.p.m., with an output of 114 to 170 cubic feet of free air delivered at 60 lb. per square inch. The horse-powers required are 29·2 and 44 B.H.P. respectively at the lower and higher ratings above referred to.

Another machine on view on the stand is a single-stage water-cooled rotary Holland/S.L.M. air compressor, with a designed output of 26 cubic feet of free air per minute, delivered at 5 lb. per square inch and 13 cubic feet at 60 lb. per square inch. The speed of this particular machine is 2850 r.p.m. and the horse-power required is 1·7 to 5·2 B.H.P. under the two running conditions named.

THE PARSONS OIL ENGINE COMPANY, LTD.

The Parsons Oil Engine Company, Ltd., of Southampton, has a considerable display of marine engines, of which we illustrate one example in Fig. 56, which also shows a self-contained reversing gear that is being made in two sizes. The smaller of these has a shaft 1¾in. in diameter and is suitable for engines of up to 75 H.P., running at 1000 revolutions

per minute. The larger set is for 200 H.P., and has a shaft 3in. in diameter.

The engine which we illustrate is of a new type, and gives from 10 to 20 horse-power, according to the speed at which it is run, which may range from 1000 to 2000 revolutions per minute. It is, it will be seen, self-contained with its reversing gear. The engine has monobloc cylinders, with a detachable

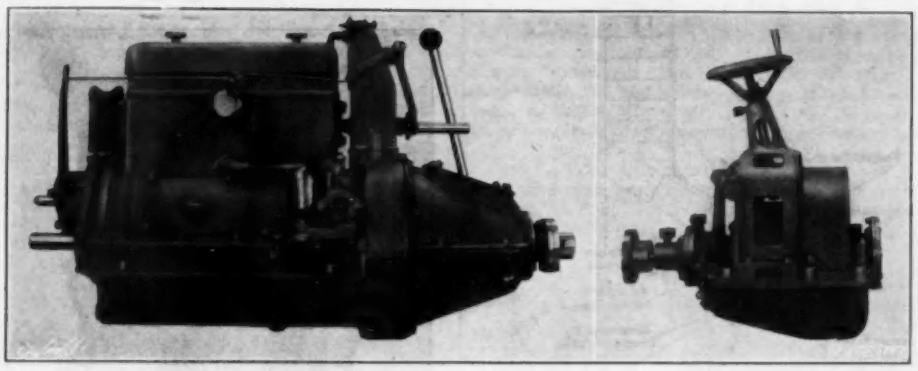


FIG. 56—10/20 B.H.P. MARINE ENGINE AND REVERSING GEAR—PARSONS

head, and may be run on either petrol or paraffin. The crank shaft has three bearings and the whole of the working parts are enclosed. It is noteworthy that the reversing gear, which is put into action by means of a multiple plate clutch, gives the same speed astern as ahead. The same type of engine, but of the industrial pattern, is also shown directly coupled to a centrifugal pump, and to an arc-welding apparatus. It is claimed that these engines will run with full efficiency at any speed between 1000 and 2500 revolutions per minute, and that the governor with which they are equipped will control the speed within very narrow limits.

Among the other engines on this stand there are an eight-cylinder marine set of from 56 to 70 H.P. running at from 900 to 1000 revolutions per minute, in which there are two bearings to every crank pin, and an industrial two-cylinder engine of 14 H.P., coupled to a dynamo and an air compressor for auxiliary service afloat. There is also a new design of engine, which is being made in several sizes, with four, six, or eight cylinders and with outputs up to 200 horse-power. The set exhibited has six cylinders and gives 110 B.H.P. at 750 revolutions per minute. It is driving a 75-kW direct-current generator.

REAVELL AND CO., LTD.

The exhibits of Reavell and Co., Ltd., Ipswich, are largely comprised of auxiliary deck machinery for oil-engined sea-going vessels, which is arranged to be driven by compressed air. Some examples of this plant are shown in our illustrations Figs. 57 to 60.

In the case of vessels fitted with propelling machinery of the oil engine type it is obviously not convenient to provide a drive for deck machinery from the main engine-room, while the torque characteristics of internal combustion engines do not lend themselves to such services. The alternative schemes for driving winches, capstans, and so forth resolve themselves into the provision of a special boiler or the distribution of power electrically or pneumatically. The Ipswich firm has, naturally, chosen the last-mentioned system, and claims for it several merits. It is, for instance, possible to provide several small persistent services, such as that of the steering engine, from a compressor driven off the main engines. Then, when the whole equipment of deck machinery is required in port it is not necessary to have an auxiliary compressor of an output similar to the demands of all the machinery, as the compressor may be run continuously and used to charge up a high-pressure receiver from which the deck is supplied through a reducing valve. The compressor would, of course, be driven by an oil engine.

Working on these principles, this firm has developed a range of deck equipment driven by means of

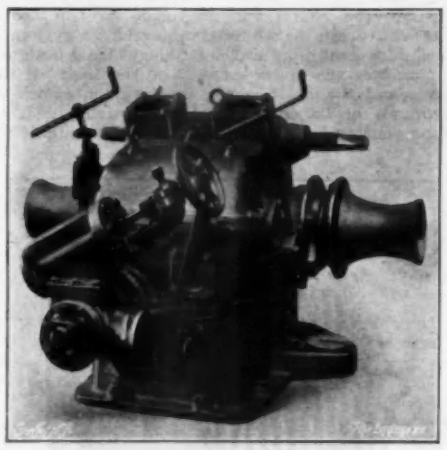


FIG. 58—PNEUMATICALLY-OPERATED WINDLASS—REAVELL

small high-speed rotary motors, which are directly reversible by means of a screw-operated valve.

In the case of the capstan, which we illustrate, the drive to the capstan head is effected through a worm and worm wheel followed by a spur reduction gear.

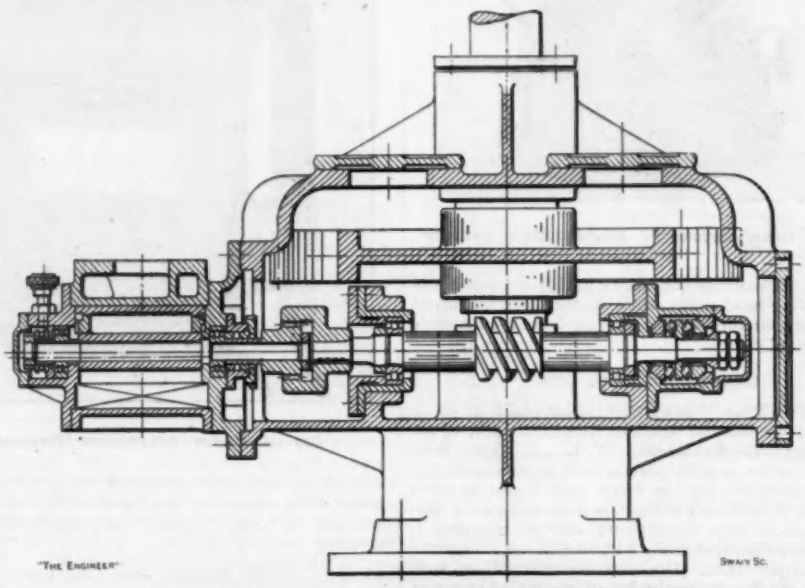


FIG. 57—CAPSTAN FOR PNEUMATIC OPERATION—REAVELL

Plain journal and thrust bearings are employed, except in the case of the worm shaft, which has ball and roller bearings. The connection between the rotary engine and the worm shaft is effected through a flexible coupling which takes the form of two concentric gear wheels, one toothed externally and the other internally. This capstan is capable of developing a pull of 15 cwt. at a speed of 40ft. a minute and is fitted with gear for turning it by hand in case of emergency.

The windlass shown is also operated by a rotary air motor through the same type of flexible coupling as that just described. The air motor is reversible and the speed reduction is effected first by worm and worm wheel and then from the worm wheel shaft to the main shaft by spur wheel gear. A small spur wheel on the worm wheel shaft can be thrown in and out of gear by means of a handle seen in Fig. 58. Either cable

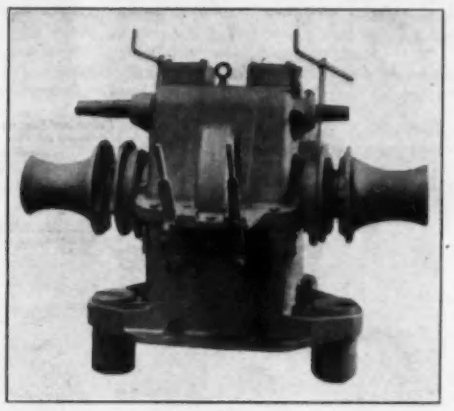


FIG. 59—PNEUMATICALLY-OPERATED WINDLASS—REAVELL

drum can be driven by means of dog clutches which are situated on each side of the large spur wheel and controlled by external handles, see Fig. 59. The warping ends may be run with or independently of the cable drums. Small worm and worm wheels on either side of the dog clutches are employed for operating the cable registers. Band brakes are fitted to the cable drum. The size of windlass shown is said to be capable of completing in eighteen minutes the operation of hauling in a 3-cwt. anchor and 60 fathoms of $\frac{7}{8}$in.

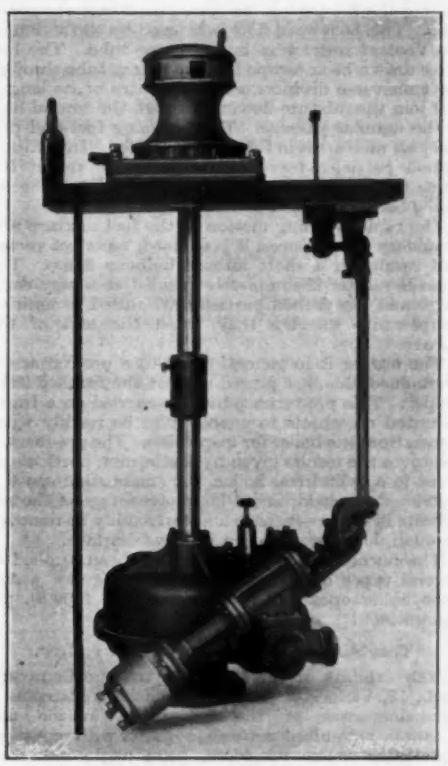


FIG. 60—PNEUMATICALLY-OPERATED CAPSTAN—REAVELL

stud link chain cable from 45 fathoms of water. When warping it is capable of exerting a pull of 15 cwt. at 22ft. a minute.

YARROW AND CO., LTD.

On the stand of Yarrow and Co., Ltd., of Scotstoun, Glasgow, there is arranged an exhibit of what is known as the Yarrow-Herbert pulverised fuel equipment. The exhibit represents a Scotch marine boiler front fitted with Yarrow patented pre-furnaces and pulverised fuel burners and fed with powdered coal by means of an "Atritor" pulveriser supplied by Alfred Herbert, Ltd. The chief feature of novelty in the exhibit is the Yarrow burner. This burner has been developed as a result of extensive experiments carried out over a prolonged period. In its final form the burner is claimed to give the shortest flame possible consistently with efficient combustion and small amount of furnace space.

The burner is illustrated in Fig. 61. Its principal part consists of an outer tube along which the pulverised fuel and primary air pass, the flow continuing through an annular space between the outer tube and an inner tube. The inner tube is supported from the outer by webs and is divided transversely near the middle of its length. In the plane of the division the outer tube is formed with a Venturi constriction. Leaving the annular passage the mixture of fuel and primary air passes through an arrangement of directing vanes which give the mixture a rotary motion. Secondary air is drawn in from the surrounding air box, and passing through a second arrangement of directing vanes acquires a swirling motion before it reaches the fuel mixture at the mouth of the burner.

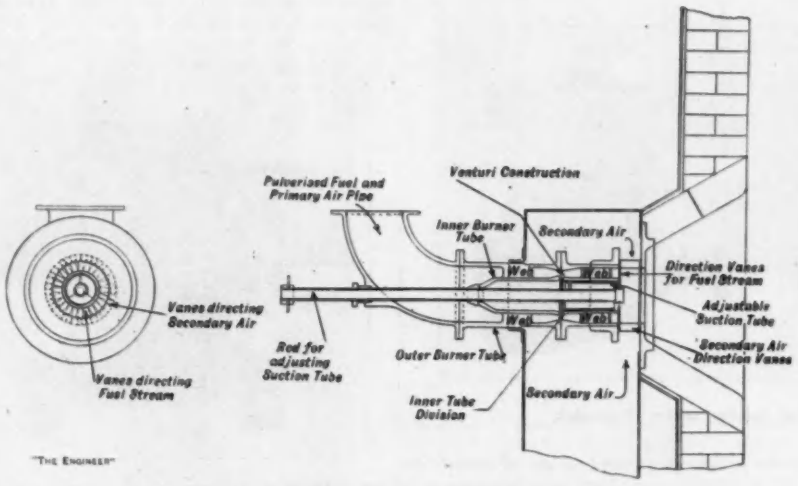


FIG. 61—PULVERISED FUEL BURNER—YARROW

Inside the end of the inner tube there is an adjustable suction tube whereby a variable portion of the inner part of the expanding vortex of burning fuel leaving the burner can be drawn back into the inner tube. This backward flow is induced by the action of the Venturi restriction in the outer tube. The hot gases drawn back escape from the inner tube through the transverse division near the centre of its length and join the mixture flowing through the second half of the annular passage. The incoming fuel and primary air mixture is in this way preheated. In addition carbon particles travelling towards the tip of the flame have their velocity checked by the drawing off of the backward flow.

The rapid whirling motion of the fuel mixture and secondary air produces, it is claimed, a perfect vortex and results in a short intense bulbous flame. The volatile matter is completely gasified at a very early stage and the carbon particles are raised to ignition temperature directly they reach the exit of the burner.

The burner is in general fitted to a pre-furnace, a brick-lined chamber placed against the furnace front proper. This pre-furnace may be carried on a frame mounted on wheels to enable it to be readily withdrawn from the boiler for inspection. The pre-furnace improves the results given by the burner, particularly if, as in a cylindrical boiler, the combustion space is restricted. In addition, a large percentage of the ash collects in the pre-furnace and can readily be removed through doors provided on its lower surface.

The burner and pre-furnace have been applied to several types of boilers, including a Yarrow water-tube boiler operating at a pressure of 1200 lb. per square inch.

The Sperry Gyroscope Company, Ltd.

The exhibits of the Sperry Gyroscope Company, Ltd., 15, Victoria-street, S.W. 1, include examples of gyro-compasses of the mercantile marine and Admiralty standard patterns, together with repeaters, automatic course recorders, helm angle indicators and other aids to navigation dependent on the gyro-compass. A new pattern of Marconi direction finder operated in conjunction with a repeater compass and a single-unit type of gyro-pilot are also exhibited. Apart from the gyroscopic exhibits, examples of Sperry searchlights are to be found on the company's stand. These searchlights are of the incandescent and the high-intensity types and are employed in one form or the other for civil, naval and aeronautical purposes. An unusual use to which they have recently been put is for the illumination of oil tanks in the East to prevent depredations by the natives under cover of dark. In Fig. 62 we illustrate a new design of 24in. high-intensity searchlight which the company is now making in this country. It is claimed that for its size this searchlight is probably the most powerful in the world. The example illustrated is equipped with spread lenses and is suitable for the flood lighting of large areas of ground. It can be mounted for that purpose on a high lattice tower and can be controlled mechanically from a station on the ground. The mechanical control system involves the use of two shafts running up the tower and operating the even crater in the carbon and thereby maintaining constant the shape and brilliance of the beam. Another feature of the Sperry searchlight system is the employment of a third electrode, which is designed to maintain the crater exactly at the focus of the mirror and thereby to assist in the maintenance of maximum brilliance. The whole searchlight is of strong construction and is claimed to be suitable for use under all weather conditions and to be capable of withstanding hard usage. All the castings employed in its construction are made of a non-corrodible aluminium alloy.

FIG. 62—HIGH-INTENSITY SEARCHLIGHT—SPERRY

Graham Amplion, Ltd.

The "Din-Proof" telephone, shown in Fig. 63, is one of the exhibits of Graham Amplion, Ltd., of 28, Saville-row, Regent-street, W. 1. It has been designed for use in noisy places, such as engine-rooms, compressor-rooms, and so forth, and it can be fixed directly to a bulkhead or may be mounted on a pillar. An extension bell forms part of the equipment. For use under exceptionally bad conditions, a separate receiver is provided. Both receivers are fitted with a rubber cap for the exclusion of extraneous sounds. The transmitter is operated directly by the vibrations of the face or neck of the speaker, which move in sympathy with the vocal organs. Another of this firm's exhibits is the cabin telephone, shown in Fig. 64, which is a new design of multiple-way telephone, evolved for communication between executive positions on board ship and on land, where louder speech is desirable than that obtained with ordinary telephones. These multiple-way instruments are provided with indicators which record calls received on various lines and also enable a superior officer to indicate his wish to speak to a subordinate, even if the latter is already speaking on another line. When using the instrument the control knob on the front of the case is first rotated until the arrow to be seen in the illustration points to the station it is desired to call. The knob is then depressed, which causes the bell to ring at the distant station. Simultaneously, it operates an indicator at the distant station, showing

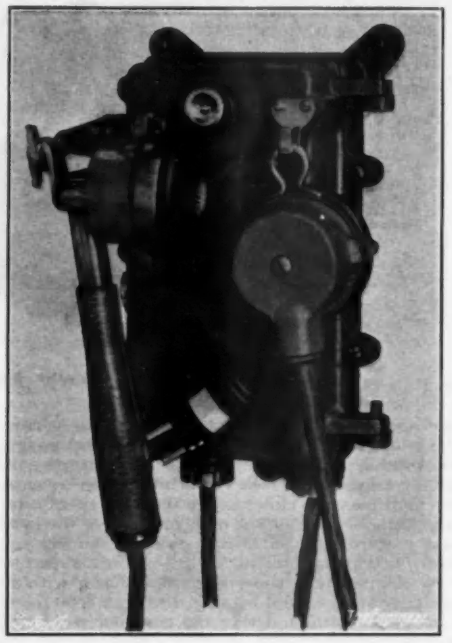


FIG. 63—"DIN-PROOF" TELEPHONE—GRAHAM

by the appearance of a red spot in the aperture the station that is calling. When the pressure on the knob is released, the instrument is ready to receive speech. On receiving a call a bell reply is first given. The speaking circuit is made by turning the knob until the arrow points to the calling position shown by a red spot on the indicator, and then depressing and releasing the knob. When the conversation has been completed, the indicators are automatically reset and the control knob is returned to the normal position by the replacement of the hand set on the cradle. On removing the front of the case all the terminals and operating parts are readily inspected or repaired.

FIG. 64—CABIN TELEPHONE—GRAHAM

J. W. Brooke and Co., Ltd.

There are two handsome motor boats on the stand of J. W. Brooke and Co., Ltd., of Lowestoft, together with the three marine engines illustrated by Figs. 71 to 73, on page 332. The boats are of mahogany, and are properly copper riveted, not put together with machine-driven screws, as are some foreign boats, and, as a consequence, are better able to stand the buffeting of a seaway. They also have a good freeboard, and should be nice and dry. The larger of the

two craft, known as the "Seacar," is 24ft. long, and has accommodation for eight passengers. Its speed is 32 miles per hour. The engine is that illustrated in Fig. 73, page 332, and is capable of developing 105 horse-power. It has six cylinders, and is noteworthy on account of its clean exterior form. The valves are of the overhead type, and their gear is driven by a silent chain. The circulating pump is also driven by a silent chain, while there is a self-contained electric starting and generating equipment. The controls for the engine and the steering gear resemble those of a motor car, and the handling of the boat is very convenient. Permanent sling plates are attached to the hull for convenience in hoisting the boat out of the water and carrying it in davits.

The smaller boat on this stand is known as a "Runabout," and will seat four passengers. It has a speed of 16 miles per hour. The four-cylinder engine —Fig. 71, page 332—develops 10 horse-power at 1500 revolutions per minute. It has electric generating and starting equipment, and is fitted with a self-lubricating reversing gear of the positive neutral type. The boat has a wind screen, a foot accelerator, and other fittings resembling those of a car.

There are several separate engines on this stand, including the six-cylinder set shown in Fig. 72, which develops 28 horse-power, and a very similar engine, with three cylinders, of 14 horse-power. These engines, it will be seen, are started by hand, and have forced lubrication. Another engine is a little two-cylinder set of 5 horse-power, which is noteworthy on account of the fact that it will run steadily at a speed as low as 180 revolutions per minute. Mechanical lubrication is employed, and there is a self-contained single-lever reversing gear. The throttle control and oil indicator are easily affixed when the engine is installed in a boat.

THE PREMIER ELECTRIC WELDING COMPANY, LTD.

Some interesting electric welding equipments are being exhibited by the Premier Electric Welding Company, of Abbey Wood, S.E. 2, a subsidiary company of Imperial Chemical Industries, Ltd. A feature of the firm's motor-generator welders is that the whole of the control and switchgear is housed in a weatherproof steel box mounted on top of the generator, as illustrated in Fig. 65, which shows a single-operator plant. There is no exposed wiring and the plant can be used under the most adverse weather conditions without fear of damaging the electrical apparatus. The generator can be driven by

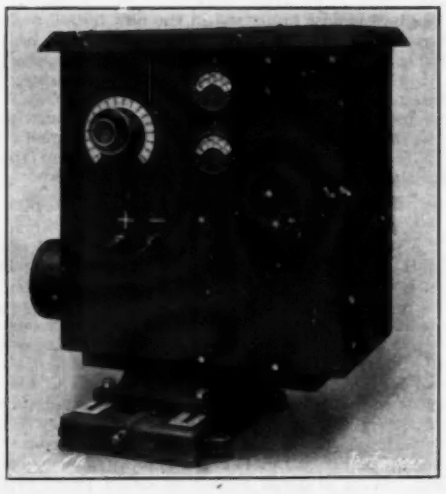


FIG. 65—SINGLE-OPERATOR WELDING SET—PREMIER

a motor directly coupled to it, or it can be arranged for a belt drive as shown in the illustration. It is also possible to provide these welding equipments with a petrol or other engine. Alternating-current welders are also on view. There is a large "Premier" transformer welder with a maximum capacity of 200 ampères and a smaller transformer welder for light work, with a capacity of 75 ampères. The former is shown in Fig. 74, page 332, from which it will be seen that the equipment is remarkably simple, and it is claimed to be one of the most efficient welders on the market. The small transformer has been specially made for sheet metal welding and has a very small open circuit voltage so as to ensure that sudden current rushes which might blow holes in the work are avoided. The plant will weld anything from 18-gauge plate up to ¼in. steel plate.

Examples of the Flexin welding tool and electrode are on view. The tool, which is illustrated in Fig. 75, is driven by compressed air, and with its aid the firm's flexible electrode, which has recently been considerably improved, can be used as easily as any electrode of the ordinary type. The electrode, which is fed forward by the tool, is fully fluxed and is claimed to give the best results and a high speed of operation. Examples of work carried out with the firm's "Belfinish" electrode are shown. This type of electrode is claimed to be very simple to use and gives an exceptionally neat finish. It has become so popular, we are told, that the works are being extended in order to meet the demand for it. Recently the electrode has been approved by Lloyd's Register. The firm's "Premag" welding process is the result of a long research on the welding of copper to obtain sound mechanical joints without interfering with the physical properties of the metal, and a large vessel kept under a pressure of 200 lb. per square inch is one of the exhibits designed to show the merits of this system of welding.

L. GARDNER AND SONS, LTD.

There are half a dozen oil engines on the stand of L. Gardner and Sons, Ltd., of Barton Hall Engine Works, Patricroft, Manchester, one of which we illustrate in Fig. 66. These engines range in output from a four-cylinder set, giving 200 horse-power when running at 290 revolutions per minute on heavy

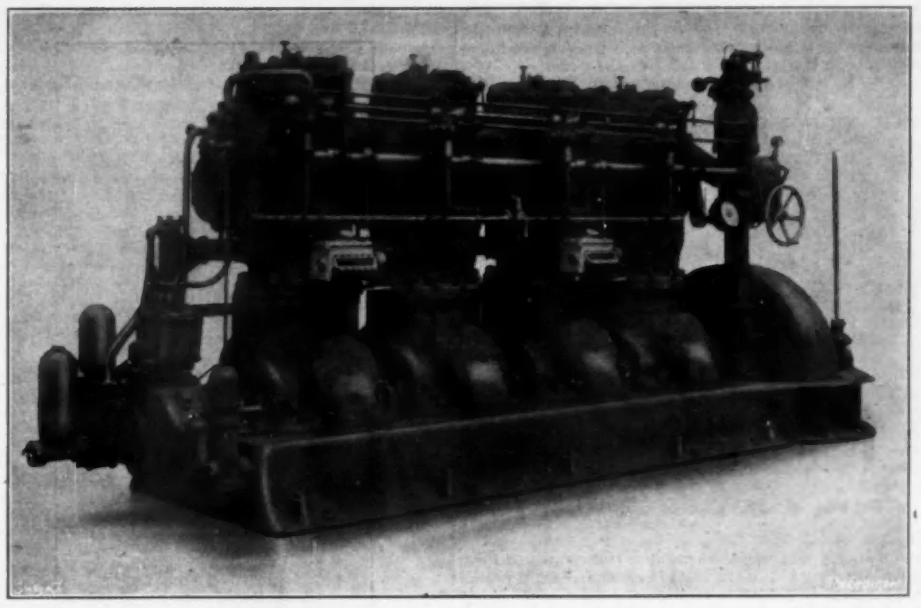


FIG. 66—FOUR CYLINDER OIL ENGINE—GARDNER

oil, down to a little 9 horse-power, two-cylinder unit, which runs at 1000 revolutions per minute and is intended for direct connection with a dynamo and two-stage air compressor.

The most novel engine on this stand is the "L" type, which works with the lighter range of Diesel fuel oils, and has been designed with the object of securing the same power-to-weight ratio as is common in the average petrol-paraffin set. It has cylinders 4¼in. in bore by 6in. stroke, and gives 9½ horse-power per cylinder when running at 1000 revolutions per minute. The fuel is injected into the cylinder by means of a pump, without the assistance of compressed air, and is ignited by the temperature of compression. It is unnecessary to use any extraneous device for producing the initial explosion, and the engine can be started by a hand crank, as compression relief gear is provided. The fuel consumption is stated to be from 0·41 lb. to 0·42 lb. per brake horse-power per hour at full load. These engines are being made in sizes from 19 to 57 brake horse-power. The balanced weighted crank shaft is carried in bearings in the lower part or bed of the engine, and access for the removal of all the bearings and big end brasses is provided by large crank case doors. The engine is fitted with a forced lubrication system working at a pressure of 30 lb. per square inch, which supplies oil to the main bearings and crank pins, the oil being forced through the tubular connecting-rods to the gudgeon pins. The whole of the valve mechanism, including the fuel pump cams and rollers and the governor, is also supplied with oil under pressure from the main system. The suction and delivery pipes of the lubrication pump are each provided with filters that are readily removable for cleaning. The governor has complete control of the engine, through a speed range, of from one-third to the full working speed. Water circulation for the cylinder jackets is supplied by a high-speed silent pump of the plunger type. The cylinders are cast in pairs *en bloc*, and the whole of the valve motion work, governor, fuel pumps, and other working parts are totally enclosed.

The overall dimensions and weight of this engine are small, considering that no light alloys are employed in its construction and that the dimension of the crank shaft, its bearings and other working parts are very generous, and, finally, that the general design is such that it will more than comply with the requirements of the various classification authorities.

HOLMAN BROTHERS, LTD.

On the stand of Holman Brothers, Ltd., of Camborne, Cornwall, there are a number of compressed air motors, primarily devised for mining work, of the reciprocating piston type. We give sectional views of one of these motors, adapted to the operation of a hoist in Fig. 67, and a view of one working

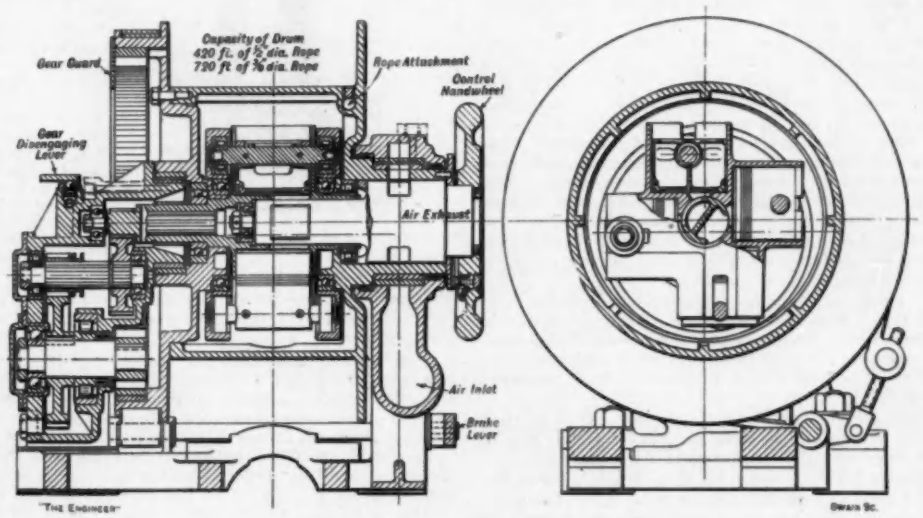


FIG. 67—HELE-SHAW BEACHAM AIR MOTOR—HOLMAN

an underground centrifugal pump by Mather and Platt in Fig. 68.

These motors, which are shown in operation, are of the Hele-Shaw Beacham design, and are characterised by the fact that the pistons operate in conjunction with excentric raceways instead of with cranks. Each piston, it will be seen, is provided with a gudgeon pin, which runs in the excentric raceways. The cylinders in which these pistons work are cast in one piece with a hollow trunnion that extends to the outside of the main casing, and carries a driving pulley or any other such device. Within the trunnion there is a distributing valve, having the inlet and

exhaust sides separated by a diaphragm. As a consequence of the pressure of the gudgeon pins on the excentric raceways, the cylinders, with their pistons, rotate, and as they rotate ports in the cylinder heads register with the ports of the central valve for the proper distribution of the motive air. If the valve is rotated through half a circle, the functions of its ports are reversed and the machine rotates in the opposite direction. There is a midway position of the valve in which the supply of air is cut off from the cylinders. The result of this arrangement is that the motor can be started, stopped and reversed conveniently by means of a single lever or hand wheel, and it is noteworthy that it develops its full torque even at the slowest speed. The air is used expansively in the cylinders, and although we have not yet any exact figures as to the air consumption of these engines, some idea of its amount may be gathered from the fact that a 20 horse-power set, working with air at a pressure of 80 lb. per square inch, can be supplied through a length of 1in. hose. Also we have noticed that the exhaust from these motors is so cold that it produces a dense cloud of moisture on a fairly dry day. We

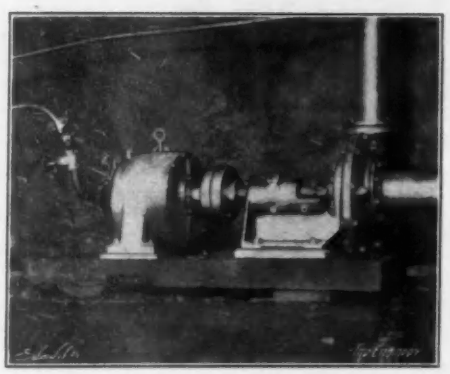


FIG. 68—AIR MOTOR AND PUMP

are told, in fact, that the exhaust temperature may be as low as 100 deg. Fah. below freezing point. There is, nevertheless no trouble through the freezing up of the working parts, all of which run on ball or roller bearings.

For winch and hoist driving, it is, of course, necessary to introduce gearing for reducing the speed of the motor, but as it runs at about 2000 revolutions per minute, it may be directly coupled to fans or pumps. On the same stand there are some compressors, embodying the same general principles as these motors.

HADFIELDS LTD.

The main feature of the stand of Hadfields Ltd., of Sheffield, is an exhibition of special steels suitable for withstanding high temperatures. The "Hecla A T V" steel maintains its strength at temperatures up to 600 deg. Cent. and has been extensively adopted in steam turbine construction, its characteristic having been found to be such as to enable it to sustain the severe conditions associated with high temperatures and impure steam. We are informed that turbines bladed with this material and developing in the aggregate over 1½ million horse-power are now in operation. Some of them have been working for over seven years at seaside and other stations where the water is badly contaminated. The makers tell us that so far they have received no report of the material having proved unsatisfactory. This steel, apart from its strength and heat-resisting characteristics, possesses the important property of being readily machined with ordinary equipment. Its coefficient of expansion is such that it readily lends itself to casting-in processes such as are employed in the manufacture of nozzle vanes.

Typical examples are also exhibited of the firm's "E R A" heat-resisting steels, materials which by virtue of their resistance to scaling, their maintenance of strength at high temperatures, their ductility, machinability and other properties are in increasing demand for use in all classes of furnaces, conveyors, retorts, muffles, and other purposes. Two of these steels, namely, those designated H R1 and H R2, are non-magnetic, while the third, H R4, is magnetic.

A new development is an alloy which is capable of being used at temperatures up to 1200 deg. Cent. and which possesses a high electrical resistance, 140 microhms per cubic centimetre over a range from 20 deg. to 1200 deg. Cent. This material is particularly suitable for the heater elements of electric furnaces. Another steel recently introduced is E R A 131. This material is particularly suitable for sustaining stress at advanced temperatures. Its creep stress at 540 deg. Cent. is two or three times as great as that of a 0·4 per cent. carbon steel. It is in use among other purposes for the manufacture of superheater tubes. E R A C.R. steel, another variety, is represented by a display of cold-drawn tubes. This steel is characterised by its resistance to corrosion and is in use in chemical and other plants dealing with acids, alkalies, corrosive salts, sea water, &c.

Another new material exhibited is Resista H Y steel. This steel is non-magnetic, possesses a high tenacity, and is easy to machine. Non-magnetic steels previously available have generally been difficult to machine and have possessed a low yield point. Resista H Y steel has a tenacity of 50 tons per square inch, a yield point of 35–40 tons, and an elongation of 30–35 per cent. Among the other steels shown on the firm's stand is the Heclon Superlative high-speed tool steel, which, it is claimed, is even capable of machining manganese steel.

W. AND T. AVERY, LTD.

Amongst the varied exhibits on the stand of the Rubber Growers' Association Incorporated, London, one that greatly interested us was a rapid gravitometer for liquids made by W. and T. Avery, Ltd., of Birmingham. This instrument—Fig. 69—is designed to allow the operator to make a rapid and accurate determination of the specific gravity

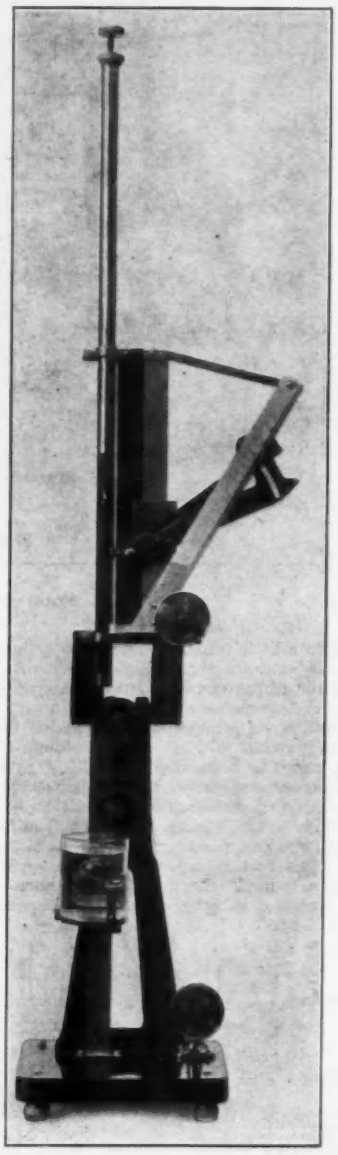


FIG. 69—GRAVITOMETER—AVERY

of most of the liquids in commercial use to-day. It works on the Archimedean principle of weighing a body in air, in water, and in the liquid of which the specific gravity is to be discovered. The actual weights are not measured, but compared. The "standard" body is suspended by a delicate spring, contained in the vertical tube seen in Fig. 69. Fixed to the main frame of the machine is a scale A E inclined at about 30 deg. to the vertical—Fig. 70. Projecting across this and behind it there is a beam inclined at 60 deg. or so to the vertical, which, by turning a knurled knob can be moved vertically on a slide. On this beam there is a movable arm which can be swung through a few degrees about a pivot near the lower end, and can be clamped in any position. A line—O Y or W X, Fig. 70—on this arm "cuts" the scale and gives the reading. The standard ball D—of brass—is suspended from the springs by a very fine chromium-plated wire, and between the spring and the point of suspension of the ball there is a disc-shaped indicator—A, Fig. 70. To set the apparatus, this indicator must be adjusted, by means of the screw at the top of the spring, to come exactly opposite a mark on a projection at the bottom of the fixed scale. A flask containing distilled water is then raised by means of the knurled knob at the base of the instrument until the ball is immersed completely. A mark on a projection from the bottom end of the beam is then brought opposite the new position of the indicator. The instrument is now "set" for the temperature prevailing.

Now if the mark at the bottom of the scale be zero, the distance between this and the new position of the indicator is a measure of the loss of weight in water. And if the ball is immersed in some other liquid the comparison of the new distance between mark and pointer with the old will give the specific gravity of the liquid. To facilitate this measurement, the arm on the beam is swung until the line upon it cuts the

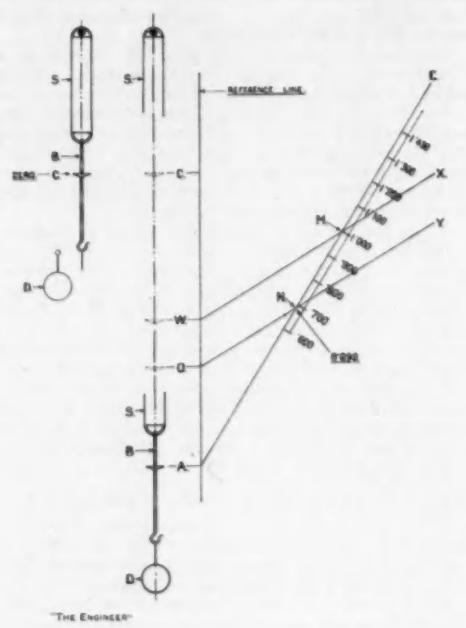


FIG. 70—PRINCIPLE OF GRAVITOMETER

scale at 1·00—M, Fig. 70. This movement of the arm will not affect the adjustment of the pointer to the mark on the beam, since the arm swings about a point on a horizontal line passing through the mark. The arm is then clamped in this position.

The ball is now immersed in the new liquid, and a different deflection of the pointer results. The beam is moved vertically until the mark upon it is opposite the indicator—see O, Fig. 70—and the reading is taken on the scale directly as specific gravity.

Accuracy is obtained by the well-known principle of the inclined scale. The range of the instrument is from 0·600 to 1·600, and the makers claim that accurate readings to ·001 may be made in 30 seconds.

P.I.V. CHAIN GEARS, LTD.

The positive infinitely variable change-speed gear made by P.I.V. Chain Gears, Ltd., 7, Princes-street, S.W. 1, was fully described in our issue of August 27th, 1926, and has since been referred to on several occasions in our columns. The gear, as our readers may recall, makes use of a self-pitching chain running over two conical pulleys, each of which consists of two coned plates formed with radial teeth on their adjacent faces. Variation in the speed of the driven shaft is achieved by moving the cones of its pulley away from or towards each other, and simultaneously moving the cones on the driving shaft towards or away from each other. With a given length of chain there must theoretically be a variation in the tightness of the chain at the different speed settings, maximum slackness occurring when the setting is such as to give a speed ratio of one to one. To take up the variable slackness a spring shoe is applied to the chain between the two pulleys. This shoe was originally arranged to act only on the upper or loose side of the chain. It is now duplicated by a similar shoe working on the under or light side, so that if necessary the direction of the drive may be reversed. As an alternative to the use of these shoes, the levers which are employed to give the simultaneous movement to the coned halves of the two pulleys can be mounted on double pivots, the action of which is such as to maintain a constant tightness of the chain at all settings.

The gear is now being made in five standard sizes in this country, France, Germany, and the United States. It is exhibited at Olympia in sizes capable of transmitting 1, 3, 5, 7½, and 10 horse-power. In all but the smallest size the gear provides a 6-to-1 variation for the speed range of the driven shaft. When the gear was first brought to the notice of engineers, there were many who expressed doubts as to the ability of the self-pitching chain—admittedly the key to the whole invention—to give satisfactory service in practice. Experience has amply shown that any fears that the chain would have but a short life are quite unfounded. The company has on exhibition at Olympia the chain from a 10 horse-power gear taken from a customer's works after having run for 26,000 hours. This chain is still good for further service.

(*To be continued.*)

Railway and Road Matters.

ELECTRICAL operation of trains by means of overhead equipment on the Southern Railway ceased on Sunday, September 22nd. All trains now use the third rail.

THE death occurred on September 12th of Mr. William Moffatt, who was for twenty-seven years the general manager of the Great North of Scotland Railway. Among the many enterprising things done by him was the construction of the locomotive, carriage and wagon works at Inverurie. Therein he was ably seconded by the late Mr. William Pickersgill.

THE Great Western Cheltenham to Paddington express, which covers the 77¼ miles between Swindon and its destination in 70 minutes, is to be continued through the winter. A year ago it was withdrawn at the end of September. The very popular 3.30 p.m. express Paddington to Torquay and the corresponding up service is also, in contrast with last year, to be kept on. The Pullman express between Paddington and Paignton is to run on Saturdays as well as on Fridays and Mondays.

THE Ministry of Transport Railway statistics for June shows that, compared with June, 1928, there was an increase of 2·6 per cent. in the number of passenger journeys, but, consequent on the reduced number travelling at full fare, the receipts from passengers show a decrease of 5·1 per cent. The tonnage of freight traffic rose by 3·9 per cent., and the freight receipts by 0·9 per cent. The average train load rose from 123¼ tons to 128¾ tons, and the net ton-miles per engine hour from 441¾ to 461¼.

WHAT was the Midland Great Western Railway of Ireland is now part of the Great Southern Railways. Its Dublin terminus is at Broadstone. At a point 1¼ miles outside that station is Liffey Junction, whence is a branch to North Wall, and shortly before the latter line passes under the Great Northern of Ireland main line the City of Dublin Junction Railway commences at Newcomen Bridge. It leads to Amiens-street—the Great Northern terminus—and on to Westland-row, where it joins the former Dublin and South-Eastern, and so reaches Kingstown—now Dun Laoghaire. As an economical measure, it is proposed to close Broadstone Station, at least in part, and to use Amiens-street as a terminus instead. The greater part of the former station is now being used as a depôt of the Irish Omnibus Company.

THE annual Railway Staff Census has recently been issued as a Stationery Office publication, price 2s. 6d. The outstanding feature is that the number of servants has been reduced from 677,148 on March 10th, 1928, to 642,137 on March 9th last, a reduction of 5 per cent. The grades in which the greatest reductions have been made are :—Engine cleaners, 10,594 to 6851; goods guards, 16,459 to 15,344; labourers, 29,131 to 25,560; officers and clerical staff, 74,115 to 72,149; permanent way men, 64,289 to 59,463; shopmen and artisan staff, 113,670 to 104,496; signalmen, 28,195 to 27,167. Of the four-grouped companies the Great Western total has fallen from 110,591 to 106,429; the London and North-Eastern from 200,517 to 190,758; London, Midland and Scottish, 262,878 to 245,412; and Southern, from 73,005 to 70,567. Before grouping the total for all the railways was 735,870.

THE Committee appointed, as related in our Seven-Day Journal on September 13th, to inquire into main-line electrification, has for its secretary Colonel A. H. C. Trench, one of the inspecting officers of railways under the Ministry of Transport. Since Colonel Trench received his commission in the Royal Engineers in 1903, he has mainly been engaged on electrical work. During the first three years of the war he was in charge of the electrical section at army headquarters, Simla, and then had command of the electrical and mechanical section of the Mesopotamia Expeditionary Force. Returning to India in 1920 Colonel Trench was, first, assistant director of military works, electrical and mechanical, Simla, and then deputy chief engineer, military land scheme, Bombay. He returned home in 1925 and was made staff officer for electrical and mechanical duties, Aldershot, which position he held until he became an inspecting officer of railways in August, 1927.

THERE was a buffer-stop collision at the L.M.S. Exchange Station, Liverpool, on June 30th, which led to thirty-eight passengers having to be conveyed to the hospital for treatment. The facts were inquired into by Lieut.-Colonel Anderson, whose report thereon was issued recently. It is said that the train ran into the station at too high a speed to stop clear of the hydraulic buffer stops, and struck them so hard as to drive them fully home. It is also observed that the shock-absorbing buffers of the second and seventh vehicles were found at the time of Colonel Anderson's inspection after the accident to have marks showing that they had recently been compressed to the full extent of their stroke. The main responsibility for the accident was placed on the driver, who entirely misjudged the rate at which he was travelling, and seriously exceeded the speed restriction laid down. Minor responsibility is placed on the guard, who should have made use of the means, ready to his hand, when he sat in his van, of taking decisive action by brake application to get the train under control.

ACCORDING to the Board of Trade returns the value of the railway material exported during the first seven months of the present year was as follows, the corresponding figures for 1928 and 1927 being added in brackets :—Locomotives, £1,807,272 (£2,219,866, £1,114,147); rails, £1,627,949 (£2,159,035, £1,545,452); carriages, £1,286,720 (£1,718,156, £1,932,725); wagons, £1,517,721 (£2,051,622, £1,410,844); wheels and axles £254,647 (£523,927, £369,714); tires and axles, £305,147 (£346,406, £332,430); chairs and metal sleepers, £293,250 (£614,417, £742,032); miscellaneous permanent way, £637,793 (£857,795, £913,326); total permanent way, £3,207,643 (£4,576,256, £4,071,432). The weight of the rails was 195,531 tons (249,728 tons, 188,371 tons); and of the chairs and metal sleepers, 29,144 tons (61,897 tons, 74,753 tons). During the month of July last the locomotives sent overseas were of the value of £262,494, and included :—India; £127,005; Ceylon, £71,936; South Africa, £1900; and the Argentine, £1720. The rail exports for the same month were £192,389, and included :—South Africa, £116,866; the Argentine, £25,325; India, £6132; British West Africa, £5698; Australia, £3264; Straits Settlements, £2200.

Notes and Memoranda.

IN putting in the foundations for the new bridge across the Mississippi River it has been necessary to sink some of the caissons to a depth of 110ft., which has involved working under an air pressure of 52 lb. per square inch.

ARRANGEMENTS are being made for the acquisition of an additional 15 acres of land for the British Industries Fair, Birmingham, which is to be held from February 17th to 28th of next year. Some spacious lounges are to be provided for exhibitors and their visitors, and an advance catalogue is to be issued early in December.

THE *Deutsche Allgemeine Zeitung* says that it learns from a good source that, after many years experimenting, the Vereinigte Stahlwerke has succeeded in producing a new copper-steel alloy called Platina-stahl, which is distinguished from previous alloys by its greater resistance to rust and longer life. One of its chief uses will, it is claimed, be for the manufacture of wire.

THE desirability of the League of Nations possessing its own wireless station in times of crisis was discussed by the Third Committee on September 11th. A resolution submitted by Viscount Cecil of Chelwood proposed that steps should be taken as soon as possible for the provision of a station capable of establishing independent direct communication between members of the League in all parts of the world. It was approved in principle and referred to a Joint Committee.

ACCORDING to Mr. W. A. Bailey, Deputy Conservator of Forests in India, if the railways would accept half-round sleepers, the number of teak and sal sleepers could be increased by about 25 per cent. and the cost reduced by about a third. The increase in the number of sleepers that could be made available and the reduction in price are both important. The half-round sleeper has already been used to some small extent on the company railways in the Bombay Presidency, with very good results, and there would seem to be no great objection to their more extended use, especially on branch and metre-gauge lines.

THE first iron railway bridge in the world has been re-erected in the York Railway Museum. It was designed by George Stephenson to carry the Stockton and Darlington Railway over the river Gaunless to the West Auckland pits, from which coal was carried for shipment on the Tees. Built in 1825, it was dismantled in 1900 and laid away, two sections being brought out for the Railway Centenary Exhibition in 1925. When the Museum was formed at York these sections of the bridge were shown there, but not the complete bridge. The other sections have now been added, and the whole framework of the bridge erected, forming an excellent illustration of early railway engineering.

A CORRESPONDENT, writing to *Aciers Speciaux et Leurs Emplois*, asks what special precautions are recommended for the heat treatment of drills in high speed steel with 18 per cent. tungsten content. In reply, the journal recommends hardening in oil at a temperature of 1250 deg. Cent. with tempering at 550 deg. Cent. The heating up should be done with great care in such a fashion that the temperature is kept very uniform and that the cutting edges do not receive a higher temperature than the rest of the piece. For this purpose the tools must be turned often in order to distribute the heat suitably. The journal adds that these tools can also be hardened, like all high speed steels, in a strong air blast. In this case they must be placed in a lantern wheel, which must turn before the source of the air blast.

A STUDY of rock bursts in the Lake Superior mining district has recently been conducted by the U.S. Bureau of Mines. The results of this investigation are summarised in a bulletin by Dr. W. R. Crane, of the Mining Division of the Bureau, to be published shortly. In this bulletin Dr. Crane describes the occurrence of rock bursts and the means of detecting their approach, also the measures necessary to prevent damage to mine operations. He analyses the cause of rock bursts and the effect of the pressure of superincumbent rock masses on mine support according to the depth of the mine workings and to the dip of the lode or bed. The action and effect of rock bursts, the failure of pillars or other support and of the hanging wall or roof rock are described, and the effect of faults, slips and joint planes on the underground mine support is discussed. In conclusion, Dr. Crane gives a number of suggestions relative to the prevention and control of rock bursts. This can be accomplished by leaving pillars systematically arranged or by block mining, in which case the ratio of pillars to area mined is from 20 to 66 per cent. respectively per 1000ft. or 5000ft. depth.

IN a number of fire-damp explosions there have been suggestions that frictional sparking or heating may have caused the ignition. In earlier research work, however, it proved exceedingly difficult, if not impossible, to ignite fire-damp by friction, and frictional sparking occurs so often in practice without ill results that it has not been generally regarded as a serious danger. Some modification of this view seems necessary having regard to the results of recent work carried out by the Safety in Mines Research Board. In a paper by M. J. Burgess and R. V. Wheeler published last year—S.M.R.B. Paper 46—it was shown that the heat generated by the impact of rock against rock might be sufficient, under certain limited conditions, to ignite fire-damp. The experiments were continued with a view to determining whether the heat of impact of metal against rock can ignite fire-damp. Experiments of this nature could not be carried out in a mine, but after a number of laboratory tests, such as the abrasion of steel by a revolving carborundum wheel, full-scale tests were made with an ordinary chain coal-cutting machine working against a built-up mass of rock in explosive atmospheres. In these tests it was found that, with certain kinds of rock, fire-damp could be readily ignited, though it is not certain whether the ignition was by the sparks emitted or by the heating of the rock surfaces caused by the impact of the coal-cutter picks. An account of this work has just been published in another paper by the same authors, entitled "The Ignition of Fire-damp by the Heat of Impact of Metal against Rock"—Safety in Mines Research Board Paper No. 54, H.M. Stationery Office, price 6d. net.

Miscellanea.

IT is said that the new pithead baths at Tilmanstone Colliery are to cost £10,000.

WORK is about to be started on the construction of a briquette-making plant at Tilmanstone Colliery, Kent.

THE estimates of the Durban, Natal, authorities for the coming year include £750,000 for new workshops at Congella.

THE American Government has approved the expenditure of 50,000,000 dollars for the encouragement of the production of tung, or China wood oil, in Florida.

A NEW generating set of 7500 kW of the Bellis–G.E.C. type is being installed in the power house of the Pretoria Municipality. It is to be on load before the New Year.

A NEW record for the flight from Shanghai to Nanking has been set up by Captain J. B. Machle with a time of one hour and seven minutes for the distance of 170 miles.

THE Pretoria representative of *The Star* reports that the Department of Posts and Telegraphs is considering the change-over, not only of the Central and other Johannesburg exchanges, but also those of the Reef towns, from the manual to the automatic system.

THE Northern Ireland Development Commission, in its report on mineral resources, estimates that the three proved coal-bearing areas in Northern Ireland contain an aggregate of about 100,000,000 tons of coal, and recommends that exploratory work should be undertaken on a scale sufficiently large to test the possibility of successfully working the deposits.

THE aerodrome which is being constructed on the waste land known as Jersey Meadows, near New York, will have four runways, for taking off from, each 3500ft. long. The material for raising the level of the swampy land is being dredged from a river, in which a big basin that will be available for hydroplanes will consequently be formed. The work involves the moving of about five million cubic yards of spoil.

FOLLOWING the practice of the last three years, an advance edition of the catalogue of the London section of the British Industries Fair is being prepared with a classified index to goods in nine languages. It will be ready on December 31st in time for it to be in the hands of most overseas buyers before they leave their homes for the Fair, which is to be held simultaneously in London and Birmingham from February 17th to 28th.

THE railway workshops' site at Pretoria has become so congested that it has been decided to remove them to a site outside the City, in the Innesdale Municipality, where a site of 78 morgen has been purchased by the Administration for £40,000. A certain amount of equipment will, says the *South African Engineer*, be retained on the present site, adjoining the station, for the purpose of carrying out minor and emergency running repairs, but the remainder will gradually be transferred to the new site.

THE Marconi Company has obtained from the Iceland Government a contract for the first broadcasting station to be erected in that country. This station will be situated at Reykjavic, the capital, and is to be completed in time for the thousand years anniversary of the discovery of the island, which will be celebrated in June next year. The transmitter will be of a new design, and will have a power of 15 kW in the aerial. It will work on a wave length of about 1200 m. Special circuits will be incorporated to enable the apparatus to be used for telegraphic transmission as well as broadcasting. This will enable the station to be used for meteorological services.

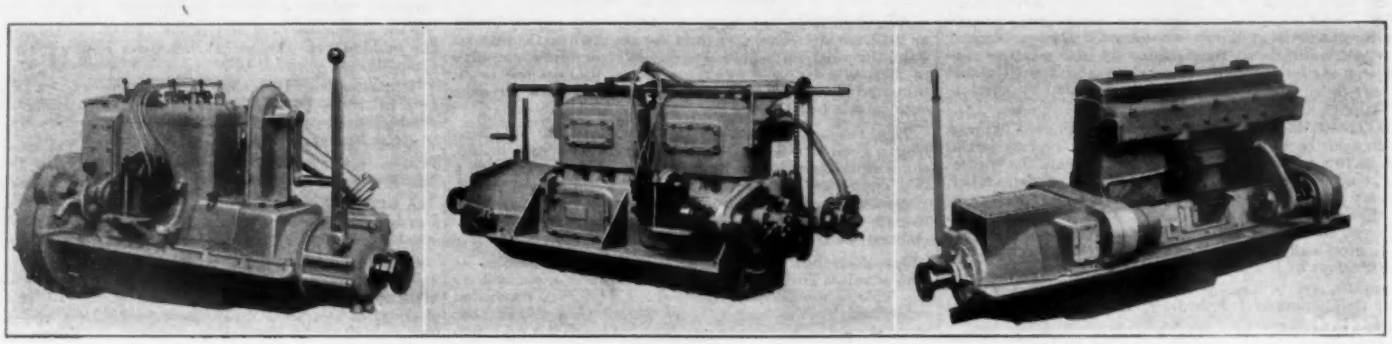
THE returns published by the Registrar-General of Shipping and Seamen record that 108 sailing ships of 12,538 gross tons were added to the United Kingdom Register during the twelve months July, 1928, to June, 1929, including 54 new vessels with a total gross tonnage of 7450 gross tons built during 1928 and 1929. More than two-thirds of these vessels were built in the United Kingdom. The number of sailing vessels added to the Register is, however, more than offset by the number removed from it. The returns show that the number removed for various causes during the period July, 1928, to June, 1929, was 196 of 20,336 gross tons, of which 64 were broken up.

A REPORT from Stockholm states that the Swedish newspapers announce that a light motor for motor cars and aeroplanes, which runs on crude oil, and is the invention of the Swedish engineer, Mr. K. J. E. Hesselman, has now definitely passed its trial period. Not much is known about the details of its construction, but the new motor is stated to have the high flexibility of the petrol motor, and to possess the characteristics of the Diesel motor. Any petrol motor can, it is said, be reconstructed for crude oil fuelling according to the Hesselman system. The newspapers further state that the Volvo motor car works at Gothenburg, which are turning out the new Swedish Volvo cars, have plans to start at once on the construction of cars with the special Hesselman motor. The papers add, further, that the rights to exploit the invention have already been secured by an Anglo-Swedish company, which has been founded in London.

IT is, says *Indian Engineering*, understood that the Mandi hydro-electric scheme will, when completed, supply energy for nineteen towns at the first stage. This is one of the biggest projects undertaken by the Punjab Government, and is a purely official enterprise as opposed to privately managed undertakings. Out of the nineteen towns, three are in Indian States, and in these the local distribution will be done by State agency. Out of the remaining sixteen towns, there are only five which are at present supplied with electricity. Of them, Lyallpur is supplied with power by the Hydro-electric Department, while Amritsar has entered into a contract for ten years to obtain all its requirements from the same Department. This leaves only three towns in which company licensees exist. Though no licensees can be forced to take power from the Government, it is anticipated that the rates at which power can be offered for sale will be sufficiently attractive to induce them to purchase all their power from the Hydro-electric Department. Negotiations to that effect are now in progress.

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION

(*For description see page* 325)



FIGS. 71 TO 73—10 H.P., 28 H.P. AND 105 H.P. MARINE MOTORS—BROOKE

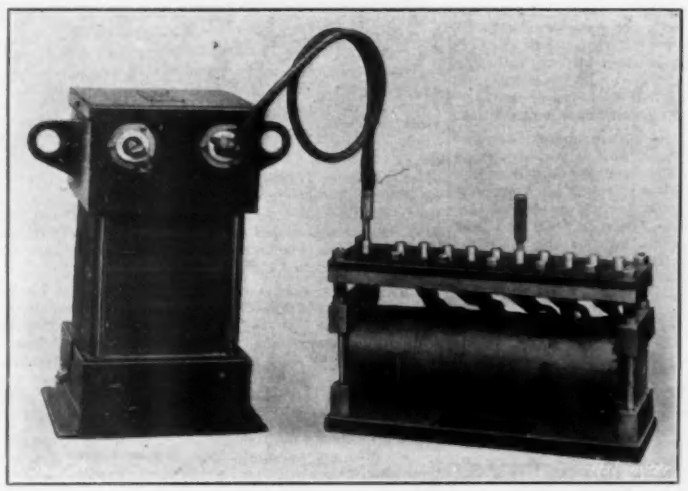


FIG. 74—200-AMPERE TRANSFORMER WELDER—PREMIER

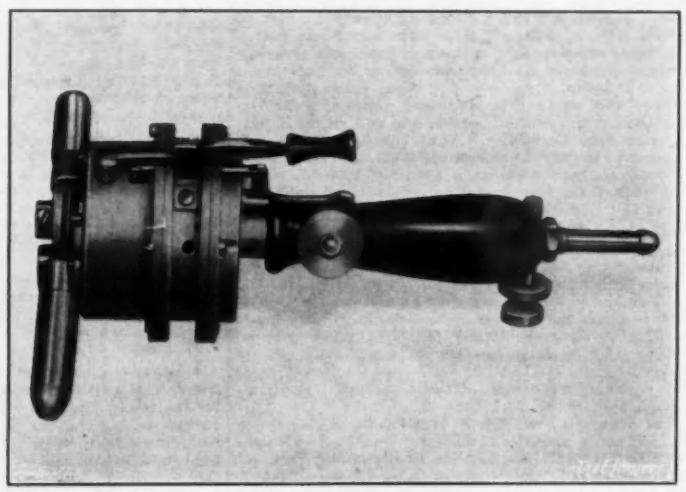


FIG. 75—"FLEXIN" WELDING TOOL—PREMIER

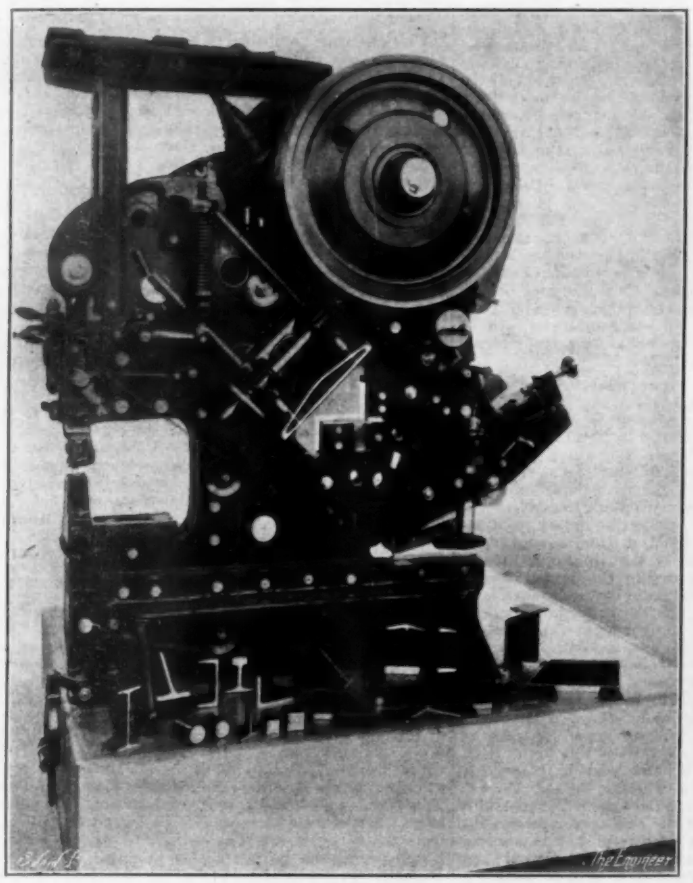


FIG. 76—PLATE-SPLITTING SHEARS AND PUNCH—PELS

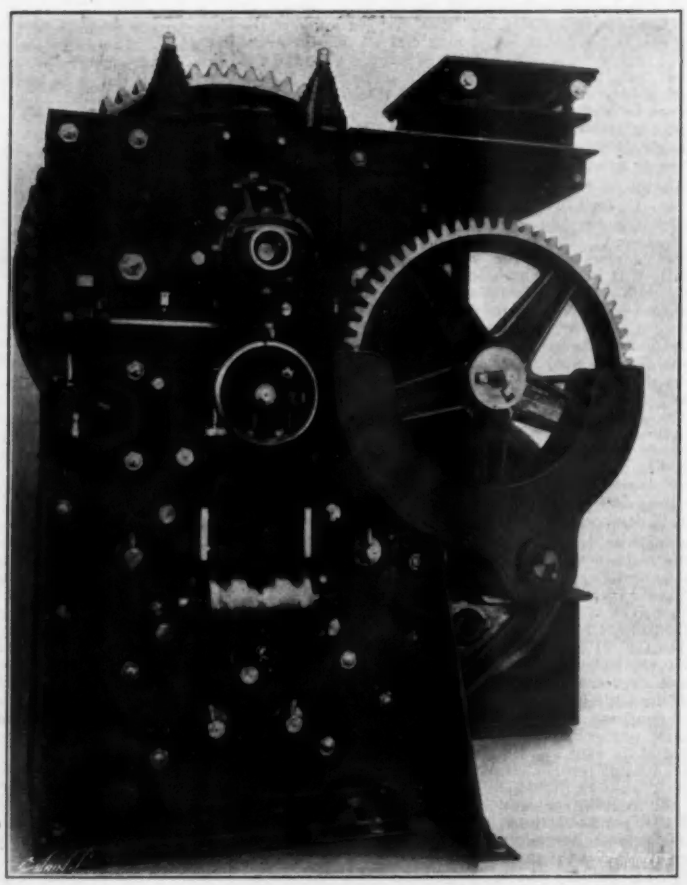


FIG. 77—HEAVY-DUTY BILLET AND SLAB SHEARS—PELS

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The Metallurgist.

THE SEPTEMBER NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE ENGINEER.

SEPTEMBER 27, 1929.

An Interesting Corrosion Problem.

OUR readers will not fail, we think, to appreciate the novelty and interest of the facts and views expressed in the article, appearing elsewhere in this issue, on the use of a zinc-containing lubricant as a means of preventing the corrosion of ferrous metals. The features of the case may be briefly summarised. In a certain device subjected in use to rapidly repeated, local stresses corrosion of a ruinous order was found to develop quickly whether the device was run dry or in the presence of an oil or grease lubricant. Prolonged investigation led the makers of the device to the belief that the corrosion was electrolytic in its origin, and that it ought to be possible, by mixing some substance with the lubricant, to convert the harmful corrosive effect of the electrolytic action into a beneficial protective effect. The substance eventually chosen was zinc oxide. When small quantities of this oxide were mixed with the lubricant little or no benefit was noticed. When, however, the amount added was some 50 per cent. or more of the weight of the oil, it was found that all corrosion troubles disappeared and that the parts, instead of corroding, became coated with an extremely thin and apparently permanent film of metallic zinc. Examination at the National Physical Laboratory has definitely confirmed the opinion that the deposit is metallic zinc and has shown that the film has a thickness of 0·0004 mm. or less, that is to say, less than the average wave length of white light, and therefore invisible beneath the microscope when viewed in section. The film is speedily established, and once established does not grow beyond a limiting thickness. That its thickness does not increase indefinitely is amply proved by the fact that the device shows no signs of jambing or seizing after it has been run for many hours in the presence of the zinc-depositing lubricant. These are the established facts of the case. They would seem to be of great scientific interest and to possess a wide significance from the practical point of view. Their theoretical interpretation must, however, for the present be approached cautiously. A considerable amount of experimental investigation has already been done on the subject, but much more, we believe, will be required before a generally acceptable theory of the action taking place can be formulated.

At an early stage of the studies which led to the discovery of the zinc-plating lubricant, the plating of the parts with cadmium in the ordinary way was tried as a means of inhibiting the corrosion. The film of cadmium speedily disappeared in use and left the parts open to the full corrosive action. An attempt was made to plate them with chromium, but it was found impossible to apply a film of this metal of sufficient thinness and evenness to avoid interference with the required dimensional accuracy of the device. Yet a zinc film of one to four ten-thousandths of a millimetre in thickness is found to give permanent protection to the parts. It would probably be found practicable to apply such a film by the ordinary processes of electro-plating, just as the cadmium film was applied. It is, however, almost impossible to believe that such a zinc film would be any more permanent and any more protective than the cadmium film. The permanency and constant thickness of the zinc film laid down by the zinc-containing lubricant cannot readily be explained otherwise than by asserting that the metallic zinc is being constantly deposited on the parts from the lubricant and that after the initial stage has been passed it is being oxidised off again back into the lubricant at an equal rate. After the parts have been run in the lubricant for many hours there is, we understand, no trace of metallic zinc in the lubricant. The zinc, it would therefore appear, passes through a closed cycle of de-oxidation and re-oxidation. What are the forces bringing about this chain of events? Are they purely mechanical or are they essentially electrical in their origin? The discoverers of the zinc lubricant believe, as we have said, that electrolytic action is at the basis of the phenomenon. They are probably correct, but a purely mechanical—or chemical—explanation should not at this stage be ruled out as unworthy of consideration. We know surprisingly little concerning the mechanical and chemical properties of the elements when spread out in extremely thin layers. Such knowledge as we do possess of them in that condition teaches us to expect properties which are not necessarily the same as, and which may, in fact, be greatly different from, those exhibited by the same elements in ordinary masses. It is quite conceivable that the zinc oxide in the lubricant is de-oxidised by a purely chemical process, that the metallic zinc is rolled on to the parts in the manner in which silver was caused to adhere to copper in the manufacture of Sheffield plate, that the zinc is removed by ordinary abrasion as fast as it is applied, and that the cycle is completed by the re-oxidation of the finely divided zinc particles removed by the abrasive action. The electrolytic theory advanced by the discoverers of the zinc grease is, we feel, not at present—or, at any rate, not as at present revealed to us—wholly convincing. The dominating practical fact has, however, to be faced that under conditions, apparently reproducing those encountered in the actual device, differences of potential of as much as a tenth of a volt have been observed to exist between two steel surfaces, the stress between which was subject to a rapid cyclic variation. The presence of any such difference of potential cannot reasonably be ignored in the search for an explanation of the phenomenon observed. It is for this fundamental reason that we believe the investigators are right when they argue that the action taking place is of an electrolytic nature. Beyond that point we are not for the moment prepared to go. In particular we desire to preserve an open mind as to the origin of the electrical stress the existence of which has apparently been demonstrated. If, as is suggested, it is, in part at least, thermo-electric in its origin, it must be a much more complex manifestation of thermo-electricity than those to which attention has previously been directed. The zinc-plating effect is, we learn, shown definitely only when the contacting surfaces are both steel or iron. It is not exhibited if one or both of the surfaces is of brass or bronze. Thermo-electric phenomena have up to now been associated essentially with the contact of two different metals. The alternative, or supplementary, explanation of the origin of the potential difference, advanced by the investigators, appears to fit in with established knowledge more agreeably than does the thermo-electric theory. It is suggested that the principle at work may be the

hitherto unsuspected converse of that in accordance with which the dimensions of a specimen of iron change when the metal is magnetised. This suggestion appears to include a hint as to why the plating effect is not observed in the case of non-ferrous—non-magnetic—metals.

The essential conditions which gave rise to the excessive corrosion encountered in the Keenok pinion, and which apparently are also required to exist before the zinc lubricant can exercise its protective effect, are, it seems, that the contacting surfaces should be of ferrous metal, that they should be subject to local stresses, and that the stresses should pass through a rapid cycle of variation. It is quite possible that the phenomenon has escaped general attention up to the present because practice, for a multitude of reasons, has unconsciously avoided the essential conditions required for its manifestation. It is equally possible that the phenomenon may provide the true explanation of certain mysterious cases of corrosion which are occasionally encountered. It is interesting in this connection to recall that in 1911 Messrs. Eden, Rose and Cunningham, in some experiments on the endurance of metals carried out at University College, London, found that some of their specimens after testing were rusted tightly into their holders in spite of precautions being taken to exclude moisture. They advanced the suggestion that the trouble was caused by a new phenomenon, the mechanical production of rust. In the course of some correspondence which ensued in our columns several other well-authenticated instances of apparently the same nature were disclosed, including the corrosion of ball bearings, keys and keyways, and two striking additional instances—one from the National Physical Laboratory—of the corrosion of test specimens. Conflicting opinions on the subject were expressed by several high authorities. It is to-day interesting and significant to note the very complete manner in which the experience of the Keenok Company's investigators and the discovery of the protective action of the zinc lubricant support the views of those who held that the production of rust in the absence of moisture is a definite physical phenomenon and is not merely an idle fancy.

Cruisers: Present and Future.

IMPORTANT changes in our policy of cruiser construction will, it seems certain, result from a naval agreement with the United States on the lines foreshadowed. We have provisionally agreed to accept a total of fifteen heavy cruisers—ships, that is, mounting 8in. guns—and this happens to be the precise number of such ships now completed or under construction for the Empire's naval forces. The conclusion of such an agreement would, therefore, automatically arrest the laying down of further heavy cruisers and restrict us in future to the building of lighter vessels armed with 6in. guns. Up to now there have been built thirteen 10,000-ton ships, including two for Australia, and two 8400-ton vessels, all carrying 8in. guns. They are, no doubt, splendid ships, but we have always maintained that the 10,000-ton type is needlessly large and far too costly for British requirements. They were built, not to fulfil any definite strategic desideratum, but to conform to the rules of the Washington Treaty. Since other nations adopted this artificial type, we were, in some measure, bound to adopt it too; but it has never been explained why an international conference held for the purpose of reducing naval armaments should have chosen to raise the standard of cruiser dimensions and armament by at least 50 per cent. Months before the present naval discussions with the United States were initiated the British Admiralty had decided to revert to smaller cruisers. It was announced last March that two of the three cruisers projected for the current year were to be armed with 6in. guns. It is probably no injustice to the United States to say that, but for her insistence on large displacement and heavy armament, a new treaty forbidding the construction of any more 10,000-ton cruisers would be accepted to-morrow by all the naval Powers. Several explanations have been advanced for America's refusal to build smaller vessels. It is urged, for instance, that her lack of oversea bases compels her to build cruisers of the greatest possible steaming endurance. Does it follow, however, that a 10,000-ton ship must have a larger radius of action than one of 7000 tons? This, surely, is a factor determined rather by the ratio of fuel capacity to steam consumption than by mere size. Nor does this question of endurance explain the American penchant for the 8in. gun, which was mainly responsible for the failure of the Geneva Conference in 1927. Finally, the whole American case for the big, heavily armed cruiser is vitiated by a fact which usually escapes attention. In 1919, when America started to build her post-war fleet, she laid down ten cruisers the design of which, as was made clear at the time, had been most carefully considered by the General Board of the Navy with reference to the broad strategic situation then existing—a situation, be it noted, which has undergone no essential change in the last ten years. Yet these ten ships, which had been so carefully planned with an eye to future requirements, had a "standard" displacement, not of 10,000 tons, but of 6600 tons, and they were armed with 6in. guns. It is therefore a justifiable assumption that the present insistence on 10,000 tons and 8in. guns is due to some motive other than strategic necessity. Not the least plausible theory is that America chose to establish a large and very costly type of standard cruiser in the hope of checking competitive building. In that case her hope has not been fulfilled. A nation, such as our own, to whom sea power is indispensable, will not be deterred from providing adequate naval defence merely because ships are expensive. It is, indeed, rather a remarkable circumstance that the only one of the five Powers affected by the Washington agreement which has shown hesitation, on economic grounds, in providing the number of cruisers declared to be necessary by its naval strategists is America herself. We shall not be so presumptuous as to offer advice to the American naval authorities, but it does occur to us that the simplest way to overcome the objection of their taxpayers to footing the bill for sea power would be to reduce the cost of warships. When we read that the lowest bid for a 10,000-ton cruiser built and equipped in the United States is £3,300,000, we can well understand the difficulty experienced by the Navy Department every year in piloting its budget through Congress.

Apart from its political aspect, the cruiser question is of particular interest at the present time in view of the number and diversity of these ships which are on the stocks or passing into service. H.M.S. "Shropshire," the last of the "London" class, was commissioned at Chatham on Tuesday, September 24th. Although of the same tonnage and armament as the five "County" ships, she and her three sisters differ from the prototype in some not unimportant respects. Designed for 32 knots, the "Londons" are faster by half a knot, they have less beam and greater length, and the external bulge has been omitted. The "Dorsetshire" and "Norfolk," comprising the "Norfolk" class, are now being completed, and should be ready for service by next autumn. So far as is known, they closely resemble the "Londons" in all essential features. Greater interest attaches, perhaps, to the "York," which should soon be ready for her trials. She is the first of the 8400-ton class and represents a welcome departure from the conventional Washington Treaty type. Official details of this ship are still scanty, but it is known that her speed is 31¼ knots and her main armament six 8in. guns. Except that her speed seems inadequate she impresses us as a better all-round bargain than the larger "County" units. In all probability her steaming endurance will not be inferior to theirs, her fighting power is considerable, and the cost is so much lower that five of her class could be built for the price of four "County" ships. Were it not for the impending naval agreement the "York" would probably have become our standard heavy type, and an excellent type it promises to be. As it is, however, she and her sister, the "Exeter," may prove to be the last 8in. gun cruisers that we shall build for many years to come. To the same generic type may be said to belong the Argentine cruiser "Veintecinco de Mayo," which was recently launched from the Odero yard in Italy. This remarkable vessel, with a standard displacement of only 6800 tons, has a designed speed of 32 knots, a bunker capacity of 2000 tons of fuel oil, and a main armament of six 7·5in. guns, with an auxiliary battery of twelve 4in. guns on high-angle mountings. The contract price for the ship, fully completed, is said to be £1,225,000. Knowing as we do the efficiency of Italian naval designers and shipbuilders, we consider this cruiser to be a thoroughly sound investment. In the 6in. gun class the most noteworthy newcomer is the German "Königsberg," lately commissioned as flagship of the Baltic command. Her displacement is 6000 tons—whether "standard" or "normal" is uncertain. She has turbine machinery of 65,000 S.H.P. for a maximum speed of 32 knots, and an auxiliary Diesel plant for cruising. Running on her Diesels alone she will, it is reported, be able to make a continuous voyage of 10,000 miles. The armament consists of nine 6in. guns in triple turrets, all training on either broadside, four 3·4in. A.A. guns, and twelve torpedo tubes. On the water line there is a 4in. belt of armour. Here, then, we have a fast and most formidably armed cruiser, possessing a wide radius of action, yet displacing only 6000 tons. Considering the disparity in age, it would not be quite fair to compare this ship with H.M.S. "Enterprise," of 7100 tons, 33 knots—in light condition—and seven 6in. guns.

Obviously, however, if our future cruisers are to be restricted to 6000 tons we must see to it that they are endowed with the highest speed, the greatest radius, and the heaviest armament consistent with Treaty obligations, and our naval constructors need not be averse from taking a hint from some of the very admirable foreign designs now being revealed. As we write we have before us photographs of the American cruiser "Salt Lake City," the first unit of the 10,000-ton type to be completed. A striking feature of the ship is the disposition of the 8in. turrets. On the forecastle stands a two-gun turret, while above and in rear of it is one containing three guns. The same arrangement is repeated at the stern. The placing of the three-gun turrets so far from the extremities of the ship is due, no doubt, to the fineness of the lines at bow and stern and the consequent difficulty of finding sufficient lateral space for the magazines and shell rooms. Nevertheless, the arrangement gives the ship a top-heavy look, accentuated by the massive foremast tripod, which is surrounded by an enormous fire control structure. Appearances are often deceptive, and it may be that the "Salt Lake City" will prove to be a better sea boat and a steadier gun platform than her profile suggests. It was, however, a bold experiment to arm a 10,000-ton ship with ten 8in. 55-calibre guns, and at the same time to equip her with machinery developing 107,000 S.H.P. for a speed of 33 knots. The "Salt Lake City" has only one sister, the "Pensacola." In the following six vessels the armament has been modified to nine 8in. guns in three turrets and other top hamper reduced. Apart from the impression of overweighting, the appearance of the "Salt Lake City" is distinctly pleasing, and her graceful hull lines show promise of speed.

Technical Education from a Student's Point of View.

No. IV. (*Conclusion*).*

THERE are two further important engineering subjects taught at the college which remain to be discussed—Drawing and Design and Laboratory Work.

At the end of the second year at college, the "mechanical" student may be excused if he is not particularly impressed by the design and drawing that he has been taught. By the middle of the third year he may be frankly puzzled. The student understands that he is to be trained as a mechanical engineer; as an engineer who is to deal with moving parts and things where "the wheels go round." At the secondary establishment to which the author went after his three years at the college, the third-year course was more practical. We dealt with pulleys—belt and rope—with gear wheels, with big ends and such things of a fairly simple nature. It is quite possible that all colleges think they teach such things; but certainly, if they do, they bury it thickly under other things more important for the examinations.

And, lastly, the Laboratory. In the writer's opinion, every engineer should be able to run a test, and he should know how inaccurate are the results that he will obtain from that test. The laboratory work is good training, therefore, and it has the advantage that all the knowledge gained in lectures and classes can be used for a practical purpose. But at the writer's college the uses of the laboratory were largely spoiled.

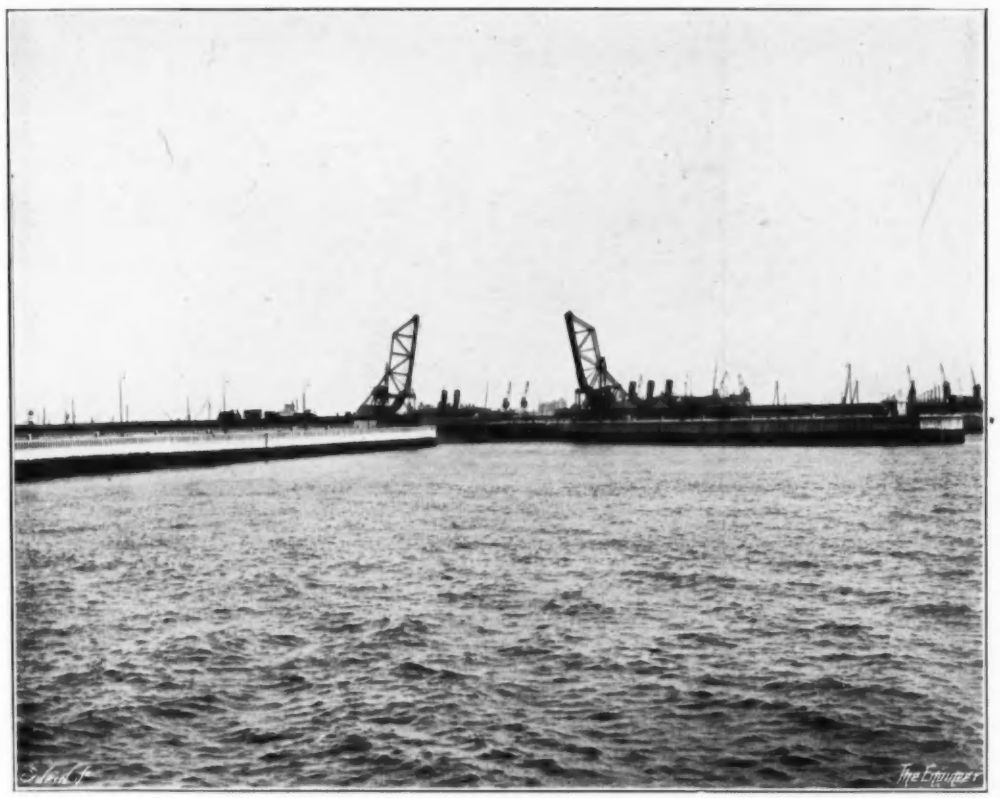
Each student kept three note-books, each for experiments in one of the three subjects—Heat Engines, Hydraulics, and Strength of Materials. He was expected to enter up in these all tests and experiments, and the books "went in" for marking at the end of each half-session. They ought to have "gone in" each week. Whether or not it was fostered by the professors, the general impression among the students was that the more "beautiful" they made their note-books, the more marks they would get. Graphs were drawn in half a dozen different coloured inks; the student would spend an hour printing "beautifully" the heading of an experiment. Photographs of each test and experiment had to be bought. Sketches were made, sketches that were so "beautiful" that anywhere else they would be called finished drawings. They were usually copied from the photographs or from the drawing in the book belonging to one of the "brains" who happened to know

* No. III. appeared Sept. 20th.

TILBURY DOCKS—NEW LOCK AND DRY DOCK

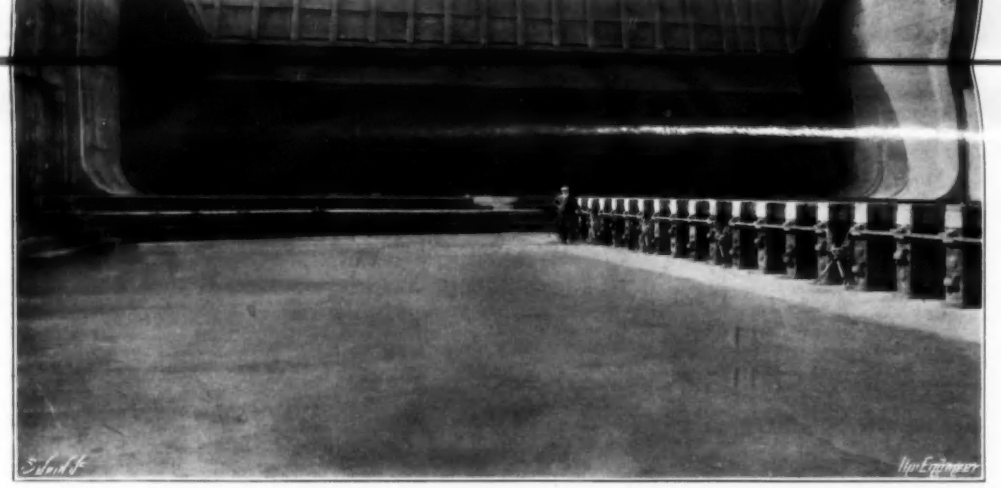
MR. FREDERICK PALMER, C.I.E., P.P. INST. C.E., WESTMINSTER, CONSULTING ENGINEER

ENTRANCE LOCK AND ROLLING-LIFT BRIDGE

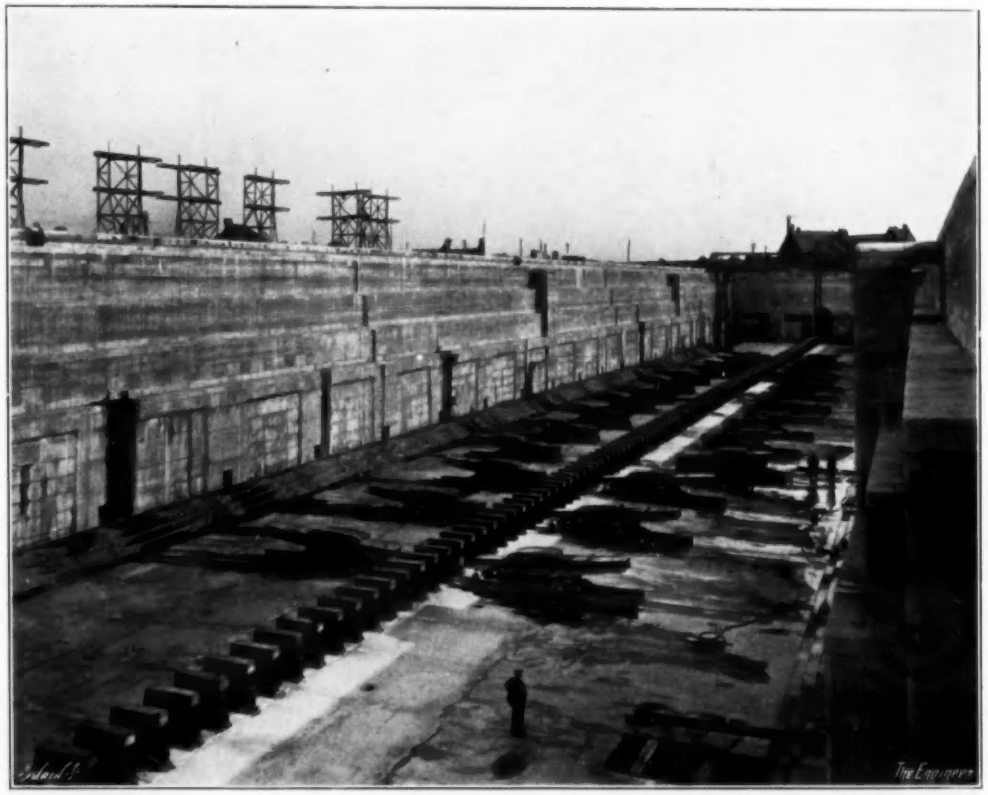


NEW ENTRANCE LOCK FROM THE RIVER

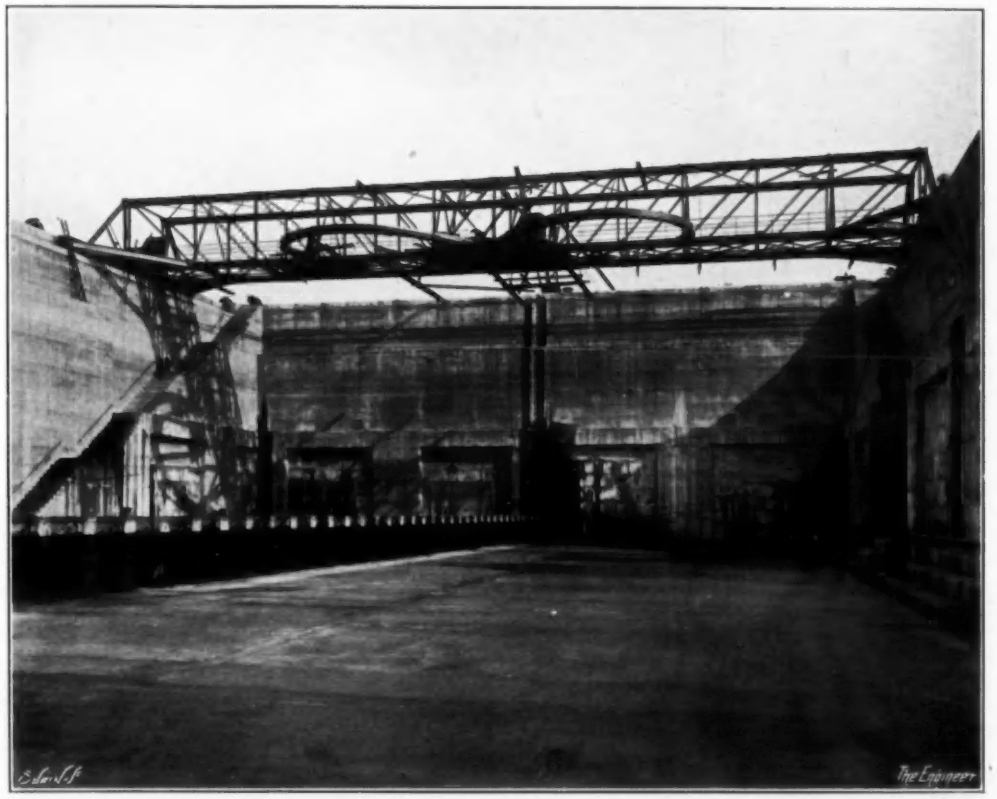
ROLLING-LIFT BRIDGE AT LOCK



DRY DOCK—CAISSON AND KEEL BLOCKS



DRY DOCK



DRY DOCK—LEADING-IN GIRDER

what the machine really looked like. In the second year, having as yet no ability at all, we were expected to make a freehand sketch of a large testing machine, as "beautiful" as possible. We did it with rule and compass!

The unnecessary work that had to be expended on these books frequently kept the student "up" till the early hours of the morning.

Now, in theory, all this is good. The student should learn how to make a good sketch, but when that sketch is expected to be a drawing, he does not learn to sketch. The student should know how to make out a good readable graph, but when he is expected to make it "beautiful" without any increase in efficiency and at a great increase in the time spent upon it in order to get marks, he is wasting his time.

In addition, the idea was fostered that tests were really accurate. Everything was worked out to three places of decimals, and no one ever suggested that because a thermometer, for instance, could only be read to 2 per cent. accuracy, it was no use to expect that the results obtained would be any more accurate than that.

And is it not ridiculous that young men being trained as engineers should not be allowed to start or stop any of the engines? At college all engines of any sort were started for us, were kept in good running order for us, and were stopped for us—as a rule we never saw how any of these things were done.

The examination system accounts for a very large amount of the complexity of the stuff that is taught in the colleges, but the colleges themselves are partially to blame for the examinations. In some cases the professors who set the papers have, owing to various circumstances over which they have little control, got out of touch with the practice of engineering, and think too much of the importance of theory. They exalt it above practice, whereas the history of engineering shows that practice is far more important than theory.

In addition many colleges lack really good lecturers: the teaching of young manhood is probably more difficult than any other. The young man will not be forced to learn; he cannot be turned over the knee of the teacher and "spanked." It is difficult to punish him in any way if he fails to work, and any attempt to do so he would take as an affront to his dignity: the personal dignity of the youth approaching manhood is colossal! He can only be made to work on a dull subject by the fear of failure; actually it is not so much that, that he fears; it is the wrath of his parents; or worse—their reproachful forgiveness. But why try to "make" him work? Why not "induce" him to work by arousing his interest? It is usually admitted that a boy must be forced to work; but, in fact, the young man is ready to work if he is interested and if his instructors show sufficient interest in his progress. There is nothing more flattering to a young man's vanity—which is enormous—than the feeling that his professor is really interested in him and his progress; and nothing more is needed to make him work.

But all this demands a really good lecturer, a real student of the young; someone who can make a lecture interesting and can then mingle with his pupils and know each one of them personally. It is no use to "palm off" a demonstrator on the student; he wants the professor himself. He likes demonstrators well enough; he knows each of them well; but he thinks of them as substitutes for the professor.

Now, the ordinary college professor has not the time for a whole-time job like this. He has researches of his own to carry out and serious work to do. But why is it considered necessary that students should be taught by the "great"? Some professors with a world-wide fame have been great lecturers; but, as a rule, it is the man who does not know so very much more than his pupils, who is the best teacher. His method of tackling a problem that rather baffles him, is an education in itself to his students. He realises their difficulties because they are very nearly his own. It is not suggested that such men should always be chosen to educate the engineer; but the man who sets out to teach should be ready to devote his whole time to it.

The method of teaching might well be altered, and so might be altered the matter that is taught. Engineering might be defined as the profession of turning scientific theories to practical uses. In the colleges to-day too much stress is laid upon the scientific theories, and they fail to teach, as they should, the best methods of putting those theories into practice. The writer hopes that engineers will pardon him when he says that the engineer is essentially a simple person; if he cannot work out by theory whether something, that he believes ought to happen, will happen, he just makes a model and finds out practically. Trial and error will show the engineer how to balance a weight rotating excentrically long before the theorist has worked it out to three places of decimals. In every machine the greater number of stresses are of unknown and incalculable value; the practical engineer simply makes the first machine strong and learns by experience—that is trial and error—how it can be made cheaper and lighter, while the theorists are quarrelling about the assumptions they can make for their calculations. In all design theory is only a guide; every time the question must be asked, "Is it practical to do this?" And frequently there comes the answer, "It must be modified." By far the greater number of engineering problems can only be solved by experiment. The engineer is "made" by experience. Why, then, should not a little "potted" experience be taught at the colleges? It is only necessary to ensure that a large proportion of the staff is composed of practical engineers.

Undue prominence is always given to mathematics; the colleges give the student the impression that, if he knows enough "Maths.," he can solve any problem, whereas the engineer uses arithmetic and algebra. If anything more difficult crops up, he gets a mathematician to draw him a curve; he is a simple person; he understands a curve or a chart: it is concrete. But he is uncertain where he stands when the mathematicians start to talk of imaginary numbers; he can understand the abstract; but he cannot understand a "dimensional" abstract. All science interests him. Recently Professor Eddington interested all engineers by stating that the material they dealt with was quite abnormal in the Universe; but the simple engineer is not worried by this statement: he is a materialist and he still has his steel and iron. It interested him to know that a ton of material from certain stars could be put into a match-box, but he would not have been at all impressed if the Professor had taken half-an-hour to demonstrate mathematically the mere possibility of this. The engineer wants the fact not the theory.

The engineer wants only sufficient mathematical knowledge to follow the theory of science; if he then believes that some particular fact will be useful he can understand its theoretical limitations and use it accordingly. But the simple engineer does not want advanced mathematical theory; the practical limitations so much modify the theory, that it is frequently just as quick to find out what can be done by experiment—trial and error.

The present technical education of the engineer in many colleges is too theoretical; practice and the manner in which it modifies the theory is left too much in the background. The method of teaching is suited neither to the character of the student nor to the subject taught. The syllabus is both too wide in its specialisation and too narrow in its generalisation. The time devoted to science is too limited; the engineer should be acquainted with every branch of science. But his knowledge need not be deep; it need only be capable of rapid extension in any sphere at will. The time that can be devoted to specialised technical subjects is too short to allow the student time to learn advanced theory; he should only be taught how to learn it for himself by teaching him thoroughly the principle on which it is based. Outside his own sphere, be it mechanical, electrical, or civil, the training should be practical rather than theoretical. The mechanical engineer should be able to run, test, and maintain an electric motor, but the method of its electrical design he can be left to learn for himself later, if he needs it.

In conclusion, the author ventures to suggest that the engineer should be taught as far as possible by practical engineers, and the teachers should mix with their pupils and come into close personal contact with them. All classes should be smaller and the supervision of the work done closer; all students should go to a "works" for at least a month in the summer vacation to discover whether they liked them. The student should take home with him each night not more than one hour's work, and the course should be reduced to a length of two years.

And finally, the great degree examination system should be scrapped!

The Institution of Naval Architects in Italy.

No. I.

THE Summer Meeting of the Institution of Naval Architects in Italy will rank very high in the series of important foreign visits made by the Institution in recent years. Although several members were prevented from attending owing to the World Power Conference in Japan, which will be held in October and November, many members and their ladies left England on Saturday and Sunday, September 14th and 15th, for Italy, and were joined by members from Holland, Belgium, and France. As some thirty-four members and fifteen ladies, resident in Italy, also came to the meetings, the whole party numbered over one hundred and fifty. Excellent travelling arrangements had been made by the Italian State Railways, in collaboration with the Italian Ministry of Communications, and the two parties travelling by way of Southampton, Havre, and Paris, and the "Golden Arrow" service, *viâ* Dover, Calais, and Paris, met in Rome on Monday evening. Mr. R. W. Dana, the secretary of the Institution, had proceeded to Italy earlier, and he, together with members of the Reception Committee and officers of the Royal Italian Navy, greeted the party on its arrival at the Rome terminal station shortly after 7.30 p.m.

The first meeting was held by the kindness of his Excellency the Governor of Rome and the civic authorities, in the Capitoleum, in which members were received with military and civic honours. Widespread regret was felt that, owing to pressure of State business, his Excellency the Prime Minister, Signor Benito Mussolini, was not able to attend the opening meeting personally, but he was ably represented by many State and civic officials.

His Excellency Prince Francesco Boncompagni Ludovisi (the Governor of Rome), in opening the proceedings said that in the name of Rome, and from the rostrum symbolical of her power on the seas, he was happy to welcome the members of the Institution of Naval Architects. Notwithstanding the new means open to the enterprise of man, the sea still constituted the readiest means of transport between peoples, and upon the sea had been measured in every age the force and power of nations. Italy, therefore, followed with the greatest interest the proceedings of the British Institution of Naval Architects, which enjoyed world-wide importance. It was not only an honour, but a matter of congratulation to Italians to be hosts for the first time of the members of the Institution. Rome welcomed them with a live sympathy, and, through him, she saluted the great nation to which the visitors belonged, and to which Italy was tied by indissoluble bonds of friendship and the common good and fortunes of the two peoples.

His Excellency Admiral Sirianni (Minister of Marine), in also extending a cordial welcome to the Institution, said that was the first time the Institution had held a meeting in Italy. The Institution during seventy years of a busy life had rendered distinguished service to science and to the art of naval architecture, and the Italians looked to Great Britain for the leaders in naval construction. They were, however, pleased to remember at the same time that during the glorious Elizabethan era, when the British Navy was born, the world had to look for the masters in the art of naval architecture to Venice and to Genoa. In welcoming the Institution, he expressed the hope that those taking part in the visit would think not only of technical matters, but would pay some attention to the national life of Italy. On behalf of the Italian Government, he offered the Institution a most cordial welcome.

The President, Lord Wemyss, expressing the thanks of the members of the Institution to the Italian Government for the warm welcome that had been given to it, and to his Excellency the Governor of Rome for permitting the meetings to be held in the Capitoleum, said that between the Italian and British nations there had been an age-long bond of community of interests in sea-borne commerce. British and Italian designers, whether for warships or merchant vessels, had often been opposed in friendly rivalry, but they had always been ready to exchange their knowledge and investigations and to profit by one another's experience. The pages of the Institution's "Transactions" had been enriched by contributions from Italy. Benedetto Brin, Soliani, Rota, Russo, Orlando, Scribanti, and Fea were names which would be found associated with some of the best contributions in our technical literature. In the domain of wireless telegraphy, the name of Senator Marconi stood out in letters of gold in the list of the world's benefactors. Only recently the Conference on the Safety of Life at Sea made compulsory the installation of wireless on ships, thus confirming the importance attached to this device by all maritime nations. The Great War was a testing period for all the allied nations which were fighting for a noble cause. Now in peace, we were able to renew the bonds of friendship which had always existed between the Italians and the British. We in Britain had been suffering under the prolonged strain of a depression in shipbuilding which had affected all maritime countries. Italy had suffered relatively less acutely than ourselves, but even now he believed there was a falling off in shipbuilding activity. Naval programmes, both British and foreign—upon which the industry used in the past largely to depend—had been reduced owing to causes outside their control. They could only passively watch—though with the greatest interest—the debates which took place on this all-important subject of naval armaments between the spokesmen of the various countries, and if it should come about that these efforts succeeded in diminishing the chances of war breaking out between the Great Powers of the world, they would have to admit that the hardship inflicted on one branch of human activity were of benefit to mankind as a whole. It required, however, a prolonged period to readjust the economic balance upon which industrial prosperity depended. We could not change over in a year or two from one or more basic industries to others with which a nation was unfamiliar. Industry could only be built up through a long series of years by patient endeavour, by investigation and research, by large capital expenditure, and, above all, by harmonious co-operation between employers and employed, without which no permanant advance was possible.

In Italy the new form of Government, of which his Excellency the Duce had been the brilliant originator and leader, had been watched with the keenest interest by the Governments of the world, which marvelled at the success which had attended his indefatigable efforts. There had been a renaissance in the economic and the industrial conditions of Italy, which had infused a new life into the body politic. He offered in all sincerity the hearty congratulations of those whose sympathies were with the great

Italian nation in its noble task of taking its full share in developing natural resources and furthering the prosperity of humanity.

The President then conferred the honorary membership of the Institution upon Signor Nabor Soliani, who, he said, had been a member of the Institution for forty-five years and had contributed many papers to the "Proceedings."

Signor Soliani, acknowledging his election as an honorary member, said he had done nothing to deserve that honour. He recalled his friendship with many British naval architects, and specially mentioned Sir Philip Watts, Sir William White, and Sir Alfred Yarrow.

Before the reading of the papers was proceeded with, his Excellency the Governor of Rome entertained the visitors to a "*vermouth d'honneur*."

Atlantic Liners.

The first paper read was "Atlantic Liners," by General E. de Vito, of which an abstract appears on page 310 in our issue of September 20th.

General G. Rota, in opening the discussion, remarked that research on the hull form which required the minimum of propulsive power was among the most difficult, yet perhaps the most important, problems to be faced by naval architects. Speaking with regard to the "Maier" form, General Rota went on to say that three years ago he came to the conclusion that, for ships of whatever size with a moderate speed-length ratio, that is, less than unity, the "Maier" form required about 15 per cent. less power than the ordinary form. At higher speeds, however, that advantage gradually disappeared as the speed was increased. In Atlantic liners of large size—say, 40,000 tons displacement—and with high speed and a higher speed-length ratio, but one still less than unity, it might be possible that the "Maier" form would show some gain.

In his paper General de Vito had mentioned several ways in which the necessary propulsive power might be reduced, and to them a further one might be added, namely, the distribution of the propelling power between the various shafts, which was investigated by model experiments made at the Spezia Tank some years ago. In quadruple-screw ships the power was generally divided equally between the four screws, but he would suggest that more power—say, five-eighths to three-quarters of the total of, say, the 120,000 to 160,000 shaft horse-power required—could with advantage be transmitted through the two centre shafts. This principle was actually applied in the Italian battleship "Dante Alighieri" and her sister ships. With the outer propeller rotating in a direction contrary to that of the inner propeller on each side a further advantage would be gained.

Sir Thomas Bell, who followed, dealt mainly with the question of weight reduction. The more closely an able naval architect looked into competitive designs the greater did the temptation grow on him to cut down weight. The late Monsieur Augustin Normand stated at one of the meetings of the Institution that every ton added to the weight of a given design of hull or machinery resulted in the addition of 4 tons to the total displacement, for the same speed and draught of water. Extra weight of machinery required a larger hull, and a larger hull required more power. The author had boldly advocated what he himself considered to be a reasonable reduction. He had taken the mean between the two extreme views held on the subject, but there was the commercial cost to be considered, and he personally was inclined to think that the shipowner would not be completely satisfied with the admirable racehorse proposed in the paper. The present-day views of some shipowners, at any rate, when considering a new and faster ocean liner were that the ship, and particularly the engine and boiler construction, must have ample proportions so as to be more reliable and dependable than ever, requiring a minimum of overhaul and repair during the passenger season, and thus enabling the time in port at each end to be shortened. The result of these combined savings with the reduction of the time on the voyage and the reduction of the time in port, would enable a quicker turn round to be made and thus enable the service to be run reliably and safely with fewer ships. Hence, without undue increase of the total capital value of the fleet, the passengers would be provided not only with vessels of increased speed, but also with more spacious accommodation, and the other advantages appertaining to ships with a large displacement, which were proving so attractive to-day in the Atlantic trade.

Engineer Rear-Admiral Whayman said that the author seemed to be aiming at an average weight of 20 S.H.P. per ton for machinery and boilers, and that seemed to be a reasonable figure, having in mind the considerations put forward by Sir Thomas Bell. Engineers regarded reliability and durability of machinery as very important. The author spoke of small-tube water-tube boilers, but from experience in the Navy he was not quite sure that the small-tube water-tube boiler had the reliability which was required on a fast liner, and he would rather suggest that it was worth while increasing the size of the tubes somewhat, if only for the sake of durability. Looking at the tables given in the paper, he noticed that the electric transmission installation was mentioned as having quite appreciably less weight than the mechanically geared installations. Figures had already been given, however, at one of the recent meetings of the Institution by Mr. G. Johnson, in which it was shown that in the same vessel with the same power, and working on the same route, the weight with electric propulsion was greater than with mechanical gearing, and, further, it was suggested that there would probably be an increase of 12 per cent. in the fuel consumption. Undoubtedly at the Admiralty the view was that there would be a greater weight with electric propulsion.

Mr. R. J. Walker remarked that the author had set an ideal in the matter of weights of machinery, but he was not at all sure that he would achieve all that he hoped to as a result, and at the same time satisfy the shipowner as to reliability, &c. His own view was that in view of the possibility of getting down to 6 lb. of oil per shaft horse-power in a vessel of from 100,000 to 200,000 horse-power—instead of ·65 lb.—the advantage so gained in efficiency might well be added to the weight of the machinery.

Mr. H. G. Williams said that the great thing about the author's figures concerning large liners was that he had to a great extent standardised them, and expressed them in the non-dimensional form in which they became of real use to the naval architect. Some of the figures which he himself had collected with regard to the "Mauretania" and the "Lusitania," however, did not agree with the author's. The apparent superiority of the Maier form from the point of view of propulsion, indicated in the paper, was very interesting. The Maier form, however, appeared to him to be rather like an exaggerated ice-breaker form, and he had never noticed that any of the ice breakers he had built or known were easier to propel than ordinary ships. With the very great engine powers now installed in big ships, the question of the maximum power that could be put through one propeller and one shaft became of great importance. The difficulty as regarded the diameter of the shaft could to some extent be overcome by increasing the revolutions at the expense of some loss of propeller efficiency, partly balanced by some gain in turbine efficiency, but very large screw shafts with the immense hull appendages which they involved, were a definite drawback to propeller efficiency. The installation of five propellers and their lines of shafting in a ship of anything like the dimensions considered in the paper did not seem to him an attractive proposition, though he supposed it would have to be faced if powers went much above a total of 160,000 H.P. As to increasing boiler pressures to 400 lb. or 500 lb. per square inch, he had been told that that was a means of fuel economy rather than a means of reducing the weight of the machinery itself. No doubt the author was right in saying that it was possible from the purely structural point of view to increase the ratio of the length to depth in future high-speed liners. Whether weight of structure would be saved by doing so depended very much on the attitude of the registration societies to any such proposal. In spite of the example of warships, he imagined that the classification societies would be very cautious in approving any great increase in that ratio. Although undoubtedly liners of higher speeds than those of any existing liners presented no great difficulty, even without increase of existing dimensions, to a naval architect with a free hand, he believed that economic considerations would operate to make dimensions still greater.

Engineer C. Sacerdoti said that in some recent tank experiments, the effect of a bulbous design was to give an increase of speed between 2 and 5 per cent. He agreed with some of the speakers in the discussion that it would be unwise to take too much away from the weight of the machinery in order to reduce the size of the ship, because ships should be built not only for making records, but for giving the best results under practical service conditions. He feared that there would be an increase in fuel consumption if the weight of the machinery was too greatly reduced.

Mr. A. T. Wall said that he agreed with the author that for passenger carrying it was impossible to have too much stability with loaded ships, and although he regarded it as one of the least of their troubles, it was a very serious matter. Naval architects had been talked at too much about keeping stability down, and that policy had resulted in too many ships being built with too little stability, and if they departed from that view and proceeded on the lines that there was not likely to be too much stability, there would be many better passenger ships. So far as bulbous design was concerned, he believed that if a normal form was adopted with normal forms of propellers, such specialities would generally fail to show any advantage under normal conditions. Under conditions that were not normal, with a bad form of ship, for instance, to begin with, or with unsuitable propellers, then specialities would show some advantage. It was, however, difficult to prove their advantage, even from the results of service records. His own practice was to take steam trial figures as the basis, and the specialities had to prove an advantage over them in actual service. The author mentioned the saving in weight of machinery by the use of a high elastic limit steel. He (the speaker) believed it could clearly be shown that if high elastic limit steel was used, although the cost per ton might be a little more, the actual cost of the ship could be reduced, both from the point of view of first cost and running cost.

The author indicated a desire to reply in writing, and a cordial vote of thanks was passed to him.

The second paper read was "Ship Design and Arrangements from the Passengers' Point of View," by Mr. A. T. Wall and Mr. Ashby Tabb.

Ship Design and Arrangements.

Mr. A. T. Wall, in introducing the paper, said that in it the ship was considered from the passengers' point of view, and that technical or economical considerations were not given primary consideration. He entered a plea for simplicity in decoration, which might, he said, be expressed in beautiful plain walls cleverly illuminated with unobtrusive or concealed lighting, and rooms furnished with real comfort. The dining saloon was best placed in the low part of the ship which minimised the rolling movements of the vessel, and enabled the best service arrangements to be carried out with adjoining kitchens and pantries. On most large ships separate restaurant facilities were desirable. Public rooms should, he held, be placed as high as possible in the ship, and an arrangement was illustrated in which passenger cabins were placed directly over the wings of the centrally placed public rooms, with the boat deck at a lower level than the cabins, so that the view from the cabins was uninterrupted. The size and arrangement of the public rooms was then discussed at some length, the authors favouring large social rooms. In the latter part of the paper, berthing, toilet and sports arrangements were discussed, and finally the important question of vibration was dealt with. The study of that question was not yet placed on a very scientific basis, and calculations were not very useful, as they did not give sufficiently accurate results. In designing both the main propelling and auxiliary machinery, greater attention should be paid to eliminating vibration troubles. Ventilation was touched upon, and it was remarked that so far the provision of cooled air had not been attempted on account of the large mechanical power required. The attitude of the passenger was: "Give me the comforts, amenities, and services of my home, my club, and my favourite hotel," and although that was a great task the authors held that it was the shipowner's business to help in the realisation of that ideal.

Sir John Thornycroft, opening the discussion, said that the naval architect now had not only to design the vessel, but also had to interpret the wishes of the passengers and explain to the shipowner how they ought to be carried out. It was a little difficult, however, to deal with that in anything like a standard manner, for all types of service. A voyage across the Atlantic was very different, from the passenger's point of view, from a voyage to Australia. On a short voyage passengers might desire a good deal of social life, whereas on a voyage to Australia there might be a tendency for them to want to get away from each other at times, and be more or less alone. The type of public room accommodation was very different in the two cases. Therefore, he thought it would be difficult to get a standard type of accommodation for all large passenger vessels.

Mr. Willett Bruce said that the question of accommodation on large vessels had caused shipowners a great deal of anxiety, and had led to some shipowners deciding to have two classes of boats, namely, the intermediate type, and what might be called the "de luxe" type. He agreed with the authors that ships must be made attractive. The most favoured arrangement for public rooms was one continuous deck throughout, and he did not think a better arrangement could be found, with the dining saloon on the lower deck and the pantry and galley services adjoining each other. Ventilation was one of the most important points, and he maintained that it had never been studied from the right standpoint. To begin with, greater use should be made of natural ventilation. Vibration was a serious matter, and should be prevented from the beginning, because if a ship once got a bad name for vibration it would never get away from it, even though the vibration might subsequently be completely eliminated. Therefore, too much attention could not be paid to having the right type of machinery at the start. There was no better type of machinery than geared turbines with high steam pressure and superheat, as had been exemplified in the newer Canadian Pacific steamers.

Mr. W. Hamilton Martin, speaking with regard to vibration, said that more attention might be paid to accurate static balancing of turbine gearing, propellers, &c. When it was remembered that the arm of a possible unbalanced couple in such rotating parts was comparatively short, it would appear that too much importance had often been ascribed to dynamic unbalance. Professor Haigh, of the Royal Naval College, Greenwich, had shown that in the case of a large liner, the two forces constituting the dynamically unbalanced couple had to be eight times as great as the single force of static unbalance to produce the same vibration in that vessel. Any critical excentricity of a rotor was liable to magnification by the elastic flexure of the shaft at the primary critical whirling speed. The critical speed of such shafts was usually designed at 25 per cent. above their running speed, to cover not only uncertainty in calculation of the true critical speed, but also to allow for imperfections in balancing.

Bearing loads depended on the ratio of running to critical speed; the more, therefore, critical excentricity was reduced, the closer was it possible to run to the cr.tical speed. The whirling speed at which dynamic unbalance first really made itself evident was far above the critical speed at which static unbalance produced dangerous effects. Preventable and irritating noises had been mentioned by the authors. In all motor ships the silencing of the engine was still done in a manner which had changed little since the first oil engine was built. Improved methods should be carefully investigated and given practical trials, so as to increase the operating efficiency and general comfort on such vessels.

Captain G. Boselli suggested that greater attention should be paid to rolling and pitching. The Sperry gyroscope had been devised to promote stability, and it was essential for stability to be obtained for the comfort of the passengers and to enable the crew to work more conveniently.

Mr. Wall, in reply, said he was very pleased to hear Mr. Willett Bruce's remarks, because the æsthetic side of the question would have to receive more attention in the future than it had done in the past.

Stability of Ships.

The next paper to be taken was that on "Breadth, Draught, and Initial Stability of Ships," by Professor M. Gleijeses, a summary of which was given in Italian by the author. The paper is a mathematical study of the variation of metacentric height, caused by altering the draught and breadth of a ship.

The President announced that, owing to the then late hour and the fact that the paper might present some difficulty in discussion, it would be dealt with by means of a written discussion, to which the author would reply.

(To be continued.)

SIXTY YEARS AGO.

As a means of establishing communication with ships at sea, a considerable amount of attention was given in the 'sixties of last century to schemes involving the mooring of floating telegraph stations along the routes frequented by vessels. Signals received from the ships were to be transmitted to land by cable from the telegraph stations. In these days of wireless telegraphy the idea appears crude and of very restricted efficiency. But in the 'sixties many people saw in it something revolutionary, something marking a fresh conquest for man's genius. To Captain Herbert of Trinity House credit for the first developed scheme for the establishment of floating telegraph stations is due. The stations were to be circular pontoons moored from their centre of gravity. The Board looked upon the scheme with disfavour, although it adopted the circular pontoon idea for some buoys which it had to place. An attempt was made to form a limited liability company to put the scheme into effect, but it proved a failure. Subsequently Mr. M. Beale, supported by "a most respectable board of directors," worked out a scheme for establishing floating telegraph stations off the Scilly Isles and off Cape Race. The service rendered by the stations was to be supplemented by steam tenders operating in conjunction with them and designed to carry stores to the ships and otherwise to help them. The prospectus of a company with a capital of £100,000 was issued in connection with the scheme, but the public refused to respond. Other schemes were advanced by other people, but all of them likewise came to nothing, until the Telegraph Construction and Maintenance Company took the matter in hand. This company, according to our issue of September 24th, 1869, had decided to anchor its cable ship "Investigator" for a few months in the chops of the Channel, and to connect her by cable to the shore in order that she might act as an advanced telegraph station. A company with a called up capital of £25,000 had been formed to finance the experiment. If the scheme proved a success it was to be considerably developed. But if it failed the "Investigator" would be sent again on her cable-laying work. The public, however, was still chary of the success of the scheme, for of the £25,000 required it subscribed only £90, the remainder being found by capitalists whose particular interest had been enlisted in the promotion of the plan. We have no record of the success or failure which attended the scheme. Presumably, therefore, it was not successful.

BOOKS RECEIVED.

Carnegie Scholarship Memoirs, Vol. XVIII. Edited by G. C. Lloyd. London: The Iron and Steel Institute, 28, Victoria-street, S.W. 1.

Short Stories in Science. By J. G. Crowther. London: George Routledge and Sons, Ltd., 68–74, Carter-lane, E.C. 4. Price 5s. net.

Northampton Polytechnic Institute, Announcements for Session 1929–1930. London: Northampton Polytechnic Institute, St. John-street, E.C. 1.

Journal of the Iron and Steel Institute, No. 1, 1929, *Volume CXIX.* Edited by G. C. Lloyd. London: The Iron and Steel Institute, 28, Victoria-street, S.W. 1.

The Manufacture of Chilled Iron Rolls. By Archibald Allison. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 8s. 6d. net.

Practical Design of Simple Steel Structures. Volume I.: *Shop Practice, Riveted Connections and Beams, &c.* Volume II., *Plate Girders, Columns, Trusses, &c.* Volume III., *Tables.* By David S. Stewart, B.Sc., &c. London: Constable and Co., Ltd., 10–12, Orange-street, W.C. 2. Price, Volume I., 12s.; Volume II., 10s.; Volume III., 5s.

A Zinc-containing Lubricant for the Prevention of Corrosion.

In the running of a certain device known as the Keenok pinion, in which rapidly varying local stresses are set up, it was found that serious trouble was being caused by the corrosion of the working parts. The corrosion occurred whether the pinion was run dry or in the presence of a lubricating oil or grease. If anything, it was most marked when the lubricant was one of several greases specially prepared to prevent corrosion in normal practice. The trouble was so great that for a time it almost threatened to restrict or prohibit the use of the gear for many practical purposes. Investigations were undertaken, and

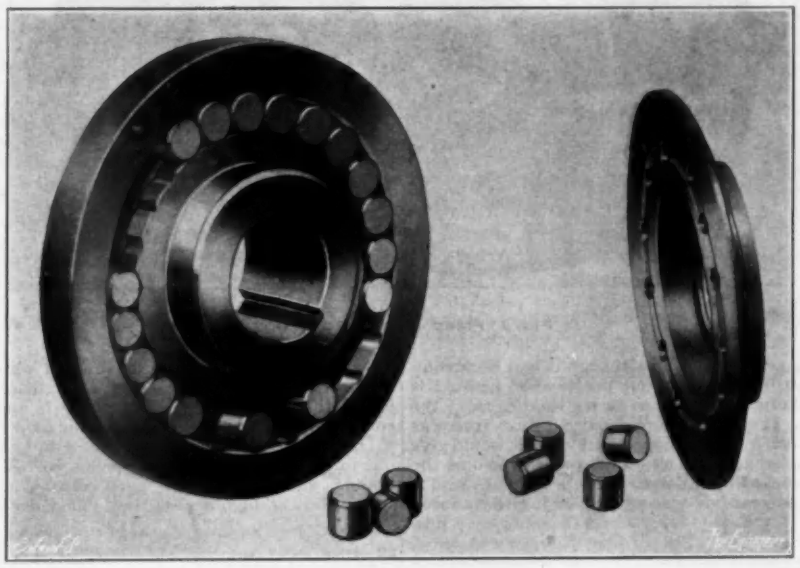


FIG. 1—THE KEENOK PINION

the conclusion was eventually reached that the corrosion was an electrolytic effect produced by the rapidly varying local stresses to which the parts were subjected. It was recognised that the conditions held to cause the corrosion were not peculiar to the particular device—the Keenok pinion—in which the phenomenon had been studied, and it was argued that other cases of serious corrosion known to have occurred in many kinds of running machinery might also be traceable to an electrolytic action. A prolonged study was therefore made of means to prevent the corrosion. The basis of that study was the argument that if the corrosion was an electrolytic phenomenon, the potential differences causing it might be made use of to deposit from the lubricant on the parts subject to the corrosion a metallic film which would stop the corrosion. After many trials successful results were eventually reached by employing as the lubricant a grease with which a considerable proportion of zinc oxide was mixed. It was found that, with such a lubricant, the working parts became electroplated with a thin film of metallic zinc—how thin, a report from the National Physical Laboratory referred to below will show. This film, it is considered, is constantly being deposited and oxidised off again, with the result that the oxidation is confined to the zinc film and does not extend into the steel parts below. All points of the theory advanced by those responsible for the investigation and the discovery of the zinc-containing lubricant may not meet with universal or immediate acceptance. But it cannot be doubted that in practice the use of the lubricant has cured the trouble formerly experienced from corrosion, while we have Dr. Rosenhain's assurance that the film deposited is actually of metallic zinc, and that it is in thickness beyond the limits of microscopic visibility.

In our issue of September 23rd, 1927, a description of the Keenok pinion will be found. For our present purposes we need only recall its fundamental features. The device is illustrated in Fig. 1. It consists of a hardened steel tire and a central member, both of which are serrated to receive between them a number of hardened steel rollers. End plates are attached to the central member to retain the rollers and the tire in position. The tire has a freedom of one or two thousands of an inch on the ring of rollers. The central member is splined for attachment to a shaft.

The pinion may be used in several ways. A simple application is indicated in Fig. 2. In this instance the pinion is being used for the transmission of power between two parallel shafts. The tire of the pinion is pressing against a plain collar on the second shaft. The pressure between the two sets the tire slightly excentric to the inner member of the pinion. The tangential force received by the rollers from the tire causes the rollers on the contact side of the pinion to move slightly up the slopes of the serrations in the tire and inner member. By so doing, they act to restore the tire to concentricity with the inner member and therefore to increase the contact pressure between the tire and the driving—or driven—shaft. The greater the tangential force applied to the tire and therefore to the rollers, the further will the rollers climb up the serrations, and consequently the greater will be the contact pressure between the tire and the driving shaft. The correlation between the contact pressure and the tangential driving force on the tire is so complete that at all loadings no slip occurs between the driving and driven shafts, even when, as is the normal practice, the whole gear is run in the presence of a lubricant.

The term "pinion" is clearly applicable to the device as employed in the manner illustrated in Fig. 2, for, so used, it gives the equivalent of two gear wheels in mesh. The speed ratio in this arrangement is constant. In another arrangement the pinion can be set to be movable radially on the face of a disc carried at the end of the driving shaft the axis of which is set at right angles to that of the driven shaft carrying the pinion. By the movement of the pinion radially on the disc, the speed of the driven shaft can be varied

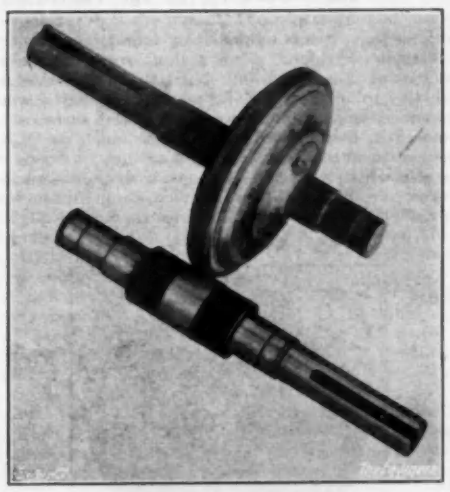


FIG. 2—FIXED-RATIO TRANSMISSION

continuously through a wide range. The action of the pinion results in the contact pressure between the tire and the disc varying automatically as the pinion is moved inwards and outwards, and in accordance with the consequential variation in the driving force to be transmitted.

As we have said, corrosion troubles manifested themselves in the running of the gear, and it was resolved to undertake experiments with a view to discovering the cause and curing it. For most of the experiments a fixed ratio gear-box of the type illustrated in Fig. 3 was used. The Keenok pinion was 4¾in. in diameter, and drove, or was driven by, a hardened steel shaft, the speed ratio being either 4 to 1 or 2 to 1. The power transmitted was usually

about 5 B.H.P., and the speed was varied from 500 to 5000 r.p.m. Some high-speed tests up to 40,000 r.p.m. were also made.

With oil as a lubricant, marked corrosion was set up at certain points, particularly where adequate circulation of the oil could not be maintained. Most of the working parts were, however, satisfactorily protected, but the employment of oil as a means of

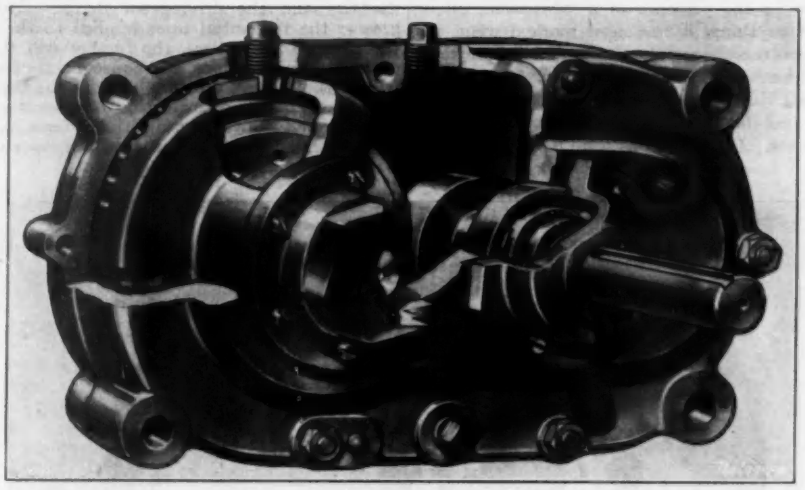


FIG. 3—FIXED-RATIO GEAR BOX

preventing corrosion, even although it had been completely satisfactory, was not practicable, because it was found difficult to prevent its leaking from the gear case. It was therefore decided to use grease as the lubricant, for it was hoped that while it would give the protection afforded by oil, it would overcome the difficulty caused by leakage.

When the gear-box was packed with grease, every working part, it was immediately found, was subject to violent corrosion. After a short run the friction surfaces of the pinion and shaft, the shaft seatings, and the roller bearings in which the shafts were supported were ruinously corroded, the surfaces in some cases being eaten away by as much as $^1/_{64}$in. The corrosion did not occur only at those portions of the gear which were called upon to withstand abrasive action. In Fig. 4 the upper view is an untouched reproduction of the shaft carrying the Keenok pinion

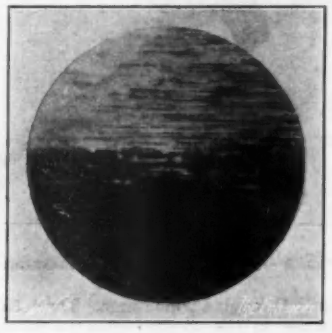


FIG. 6—PLATED AND UNPLATED SURFACES × 300

in one of the tests. Originally, the pinion was a tight push fit on the shaft, and was keyed to it in the usual way. After a run of only 300 hours, the seating on the shaft had been reduced in diameter by nearly $^1/_{64}$in., the keyway had become badly eaten away on one side—the lower in our engraving—and about one-third of the metal of the key had disappeared. This corrosion took place in spite of the fact that there was no possibility of abrasive action occurring between the pinion and the shaft. Similar violent corrosion was exhibited on the seatings for the roller bearings.

It was observed that there was a distinct difference between the corrosion occurring at the seatings of the shafts and that taking place on the surfaces possessing rolling motion. The seatings were rough and appeared as if they had been etched with a strong acid. The surfaces having rolling motion were corroded to a smooth glassy finish, and were stained reddish-brown. On analysing the grease, it was found that its acidity had increased, and that it contained a large percentage of iron oxide.

Different greases varied somewhat in their action, but in general the result was severe corrosion. Two brands gave moderately good results at normal speeds, but at high speeds they failed completely to stop the corrosion. More than fifty different types of lubricant were tried, including greases with a lime, soda, and a graphite base. Several tests were carried out entirely without lubricant. The whole gear in these cases was, as a preliminary, carefully cleaned and thoroughly dried, and the inside of the gear-box was enamelled white to ensure that no effect would be produced by the cast iron case. In every instance serious corrosion resulted. Iron oxide was found sprayed evenly over the enamelled surface, and could be wiped off as an impalpable red dust. Altogether, about one hundred recorded tests were made, covering the running of the gears for nearly 10,000 hours.

The severity of the corrosion appeared to vary with the power transmitted, and with the speed of the gears, the corrosion occurring more rapidly as the load became heavier and the speed higher.

As a means of stopping the corrosion the gears were plated with cadmium. Tests showed that no satisfactory solution could be reached in this direction, for the cadmium coating oxidised rapidly and left the steel exposed. Chromium plating was found to be impracticable, because of the difficulty of coating the hardened surfaces without affecting the dimensional accuracy of the gears.

By the time these various tests had been completed, those responsible for the experiments felt convinced that the corrosion was an electrolytic action. The electrolyte, it was argued, was provided by the grease or other lubricant, and the electrical stress by the rapid variation of the local contact pressure on the parts of the gear. This theory led to the suggestion that protection against corrosion might be secured if a lubricant anodic to the steel could be discovered. With such a lubricant it was thought likely that the electrolytic couple established would prevent the ionisation of the steel, and might even lead to the electrical deposition on the steel surfaces of a film of the anodic material.

As a preliminary test of this theory, test pieces of steel were immersed in a dilute acid bath, to which were added various substances having a higher solution pressure than steel. The results were encouraging, particularly when the added material was zinc oxide. With zinc oxide present in the bath, the steel test pieces, it was found, remained quite clear after several days of immersion. The protection against corrosion, it was argued, was obviously electrolytic, for in every case the bath was still strongly acid after the zinc oxide had been added, and remained in that condition throughout the test.

Zinc oxide was, as an outcome of this test, chosen as the material for adding to the lubricant. Numerous mixtures were made containing various percentages of the oxide with mineral oil as the lubricant, although in some cases different fats were tried as the vehicle for the oxide. When the percentage of zinc oxide in the lubricant was small, little or no protection against corrosion was afforded. When, however, the percentage was brought above 50 the protection obtained was all that could be desired. After the gears had run continuously for a time, the frictional surfaces were found to be plated with metallic zinc. By increasing the percentage of the oxide in the lubricant still further, the plating was obtained in a reduced length of time.

Since the first experiments with the zinc oxide grease were made, well over a hundred tests, covering about 15,000 hours' running, have been carried out with it. The Keenok Company is completely satisfied with the protective action of the grease,

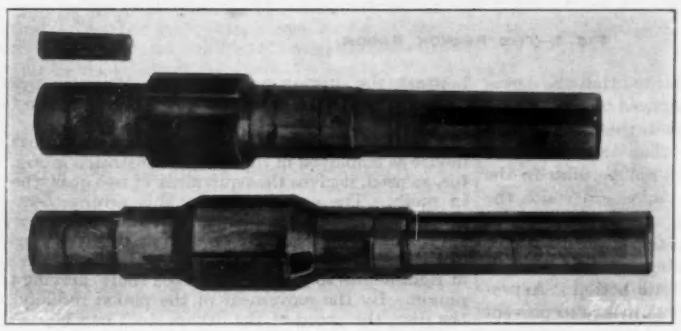


FIG. 4—UNPROTECTED AND PROTECTED PINION SHAFTS

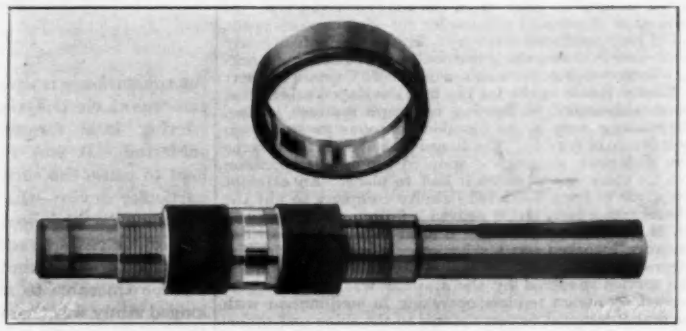


FIG. 5—ZINC-PLATED SHAFT AND ROLLER BEARING RACE

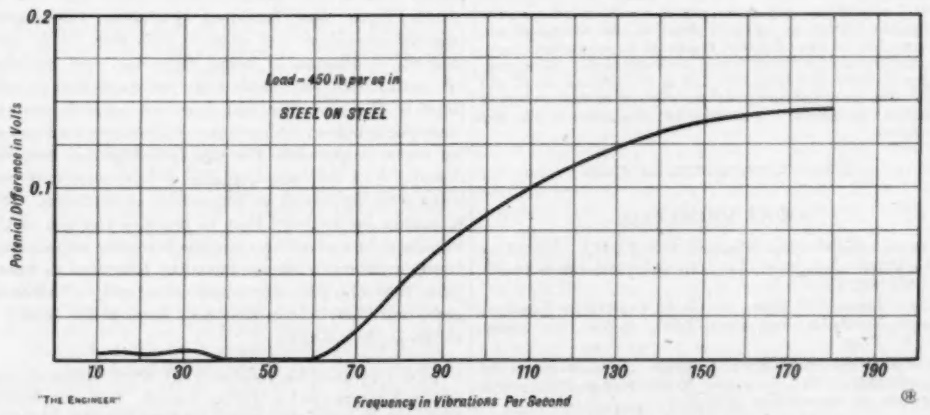


FIG. 7—POTENTIAL DIFFERENCE BETWEEN TWO METAL SURFACES UNDER PRESSURE

and with its capacity to electro-plate the working surfaces. At every point at which corrosion previously occurred an adherent film of metallic zinc is now found deposited. The lower view in Fig. 4 shows a Keenok gear shaft after six months of continuous service, with the zinc grease as lubricant. No corrosion has occurred anywhere on it. On the running surfaces of the tire and the shaft with which it engages, the metallic zinc is deposited with a mirror-

like surface finish. Such a tire and shaft have been in our possession for two or three months, and have been exposed unprotected to the atmosphere and to repeated handling. The zinc coating remains fully adherent, and has suffered little tarnishing. In Fig. 5 we reproduce photographic views of a shaft from a Keenok gear-box and of the outer race of a roller bearing after they had been run for some time in presence of the zinc lubricant. The mirror-like zinc plating of the rolling contact surfaces is clearly visible. In Fig. 6 we reproduce a photo-micrograph taken under a magnification of 300 diameters showing the junction of the plated and unplated surfaces, the lighter area representing the plated portion.

It might be thought that the use of an electro-plating lubricant would be an impracticable, if not dangerous expedient to resort to as a means of preventing corrosion in any device which depended for its action on the exactness of its dimensions. The film deposited by the zinc grease is, however, so very thin that it is well beyond having any measurable effect on the dimensions. The thickness of the film does not increase as time passes. It remains constant. The action taking place would appear definitely to be a closed cycle, consisting of the deoxidation of the zinc oxide, the deposition of metallic zinc on the steel parts under load, and the oxidation of the zinc back into zinc oxide. The rate of deposition of the metallic zinc just balances the rate at which oxidation takes place, with the result that after an initial layer of zinc has been formed on the steel, its thickness remains unchanged. In effect, therefore, the oxidation which originally took place in the steel has been transferred to the zinc film and leaves the steel unattacked.

It might also be thought that the deposition of the zinc would have the effect of softening the surface. The actual result appears to be the reverse. The contact surfaces of the gears after a period of continuous running are, we are informed, noticeably harder than they were before the steel was coated with zinc.

That the lubricant has applications far outside that for which it was originally produced, is suggested by the result of a trial in which it was applied to the roller chain of a light motor car. The chain had been very slack, and before the zinc grease was applied to it, was intentionally tightened rather more than it should normally have been, for past experience showed that it slackened rapidly in service. After the chain had run for three months in the presence of the zinc lubricant, it was found still to be tight. Further investigation of this interesting phenomenon seems, we think, to be called for, in order to determine the precise function exercised by the grease in preventing the stretching of the chain. The suggestion at present would appear to be that the chain formerly had stretched by reason of wear in its parts, and that the zinc grease had inhibited that wear.

Last May a portion of a coated tire from a Keenok gear was submitted to the National Physical Laboratory for examination. At the same time three roller bearings and a supply of the zinc grease lubricant were sent to the Laboratory in order that the Laboratory itself might be responsible for the zinc coating which it was asked to examine. The following is a copy of the official report. The photo-micrograph referred to in it is not reproduced, since, as will be gathered, it exhibited nothing.

Report on the Chemical Analysis and Metallurgical Examination of Components of Bearings Submitted by Messrs. Keenok Gears, Ltd.

The material submitted for examination consisted of a portion of the outer tire from a Keenok gear wheel, together with three roller bearings having the dimensions 30 mm. by 62 mm. by 16 mm. It was desired to know whether the tire was coated with zinc on the outer surface, and what was the thickness of the coating, and also whether the roller bearings became coated with zinc on running in a lubricant supplied by Keenok Gears, Ltd.

The three roller bearings have been subjected to the following treatment in the engineering department of the Laboratory :—

Bearing. No.	Duration of run, 3000 r.p.m. Hours.	Load.
1	25	80 lb.
2	50	50 lb. for 23½ h. 70 lb. for 26½ h.
3	70	50 lb. for 2h. 3 min. 70 lb. for 67 h. 57 min.

The present report deals with the chemical analysis and metallurgical examination of the tire, and of the three bearings after the above treatment.

Preliminary Examination.—The outer face of the portion of tire submitted had a uniformly highly polished appearance, resembling a buffed surface on a comparatively soft metal rather than hardened steel. The inner faces of the outer races of the roller bearings also showed a bright surface after running, but the polish was not so lustrous nor so uniform as that on the tire.

Chemical Analysis.—After cutting out a small specimen for microscopic examination, each of the four samples has been subjected to chemical analysis, with the object of determining the total quantity of zinc on the surface. The results of these determinations are given in Table I.

TABLE I.

Sample.	Total zinc on surface. Gramme.	Area of bearing surface. Sq. cm.
Keenok gear tire	0·0015	5
Roller bearing No. 1	0·0009	13·5
Roller bearing No. 2	0·0008	13·5
Roller bearing No. 3	0·0008	13·5

The above results show that zinc is present on the surface of all the samples examined, but that the quantity of zinc is extremely small. The areas given in Table I. refer to the outer surface in the case of the tire, and to the inner surfaces of the outer races in the case of the roller bearings. In the latter the area considered is that which comes into contact with the rollers, 8 mm. in length.

Assuming that the zinc is uniformly distributed over the outer surface of the Keenok gear tire, and taking the value of 7 for the density of zinc, the approximate thickness of the zinc coating is calculated to be 4×10^{-4} mm., that is, 0·4 μ. In the three roller bearings the zinc coating is probably not of uniform thickness, but the average thickness is of the order of 1×10^{-4} mm.

Metallurgical Examination.—Chemical analysis shows that the thickness of the zinc film on the Keenok gear tire is of the order of 0·4 μ (0·0004 mm.), and that the coating on the roller bearings is probably even thinner. As this thickness is rather smaller than the average wave length of white light, the film would be expected to appear only as a single line in transverse section. A specimen from the tire has been prepared for microscopic examination by plating with copper, in order to preserve the zinc-coated edge, sectioning, polishing, and lightly etching in a very dilute alcoholic solution of nitric acid. Fig. 1 is a photo-micrograph at a magnification of 1500 diameters, showing the edge of the tire on which the zinc has been deposited. As was to be anticipated, no definite indication of the presence of the zinc film is obtained from microscopic examination.

Since the quantity of zinc on the roller bearings is even less than that on the tire, microscopic examination fails to reveal the zinc film on them also.

Conclusions.—Chemical examination of the Keenok gear tire and of the races of roller bearings which have been run at the Laboratory in a lubricant supplied by Keenok Gears, Ltd., shows the presence on these surfaces of a very thin film of zinc, of the order of 0·0004 mm. in thickness. The fact that the presence of a zinc film cannot be observed microscopically on a transverse section of the tire confirms the conclusion that the thickness of the film is of the order indicated by chemical analysis, and is, therefore, below the limit of microscopic visibility.

(Signed) WALTER ROSENHAIN,
for Director.

Date, June 28th, 1929.

In discussing the theory of this lubricant a fact which may not be unimportant is that so far as present investigations have gone the plating effect is not noticed if the surfaces in contact are of non-ferrous metals or alloys, and is only marked in the case of steels and iron.

The discoverers of the lubricant have made a close experimental study of the fundamental physical and electrical conditions on which in their view the plating effect depends. Something more may be heard shortly on this, the theoretical, side of the subject. Here we can only present a brief account of the argument. It is to be understood that in what follows we are reproducing the views of the investigators, and that while we do not feel prepared to dispute them, it is not to be taken that we necessarily agree with them.

When two metal surfaces are brought together suddenly under pressure, an electric stress, it is argued, is produced at and around the point of contact. The origin of this electric stress may be traced to the fact that the pressure develops heat and, as a consequence, thermo-electric phenomena may be expected to occur. As an alternative or supplementary source of the electric stress, it is observed that magnetic effects, as is well known, cause slight alterations to take place in the dimensions of iron specimens. It seems, therefore, legitimate to argue that the converse will hold good, namely, that slight alterations in the dimensions of a specimen of iron will give rise to magnetic effects. This aspect of the subject has not so far attracted much attention from research workers.

Whatever be the cause of the electric stress, the fact that it is manifested is regarded as definitely established. The surfaces under direct pressure are held to acquire a charge of negative electricity while neighbouring surfaces are charged positively. In most cases these charges disappear almost immediately by conduction through the metal. If, however, the action is repeated continuously, an alternating electric stress is produced and the surfaces become alternately positive and negative. If the periodicity of the application of the pressure is high—as, for example, in parts rolling rapidly under pressure—considerable differences of electric potential may, it is held, occur.

In many forms of running machinery these conditions for the establishment of surface differences of potential exist. It therefore only requires the presence of a suitable electrolyte to set up the electrolytic corrosion of the surfaces. Such an electrolyte, it is contended, is commonly provided by moisture or impurities in the air or by the lubricant, if one is used.

An investigation, the full details of which will probably shortly be published, was undertaken to measure the extent of the potential differences which occur when two metal surfaces are brought together suddenly under pressure and to determine how these potential differences varied with the magnitude of the pressure and the frequency of its application. The general nature of the results, so far as the magnitude of the potential difference and its dependence on the frequency of application of the pressure are concerned is indicated in Fig. 7. It will be observed that under a constant load of 450 lb. per square inch, no potential difference appears until the frequency reaches 60 per second. It then increases linearly for a time until at very high frequencies it approaches a constant value. The curve, it is considered, lends itself to easy interpretation. At the lower frequencies, the potential difference is dissipated too rapidly to be measured. The higher portion of the curve represents the maximum value of the potential difference when the loss by dissipation is overcome by the speed of application of the pressure. Many other considerations, it is realised, affect the form of the curve. Mathematically, the curve can be expressed by the formula—

$$V = k\,(n - n_0)\,e^{(a-n)}$$

where a, k, and n_0 depend on the conductivity of the material and its elastic constants.

In conclusion, it may be stated that patents covering the zinc-depositing lubricant have been applied for in all the principal countries of the world.

The Wireless Exhibition.

THE Wireless Exhibition which was opened in the new hall, Olympia, on Monday, September 23rd, and which closes on Thursday, October 3rd, is the most important exhibition of its kind that has been held in this country. Since the first Radio Show promoted solely by an association of manufacturers was held at the Royal Albert Hall in 1924, the progress made has been little short of marvellous. Much has been done since that Exhibition in the way of producing receiving apparatus of greater range, selectivity and purity of reproduction. The present Exhibition, organised by the Radio Manufacturers' Association, reveals to the public the latest developments in receivers, component parts, speakers, batteries, and other accessories. Whereas in the early days of broadcasting, crystal sets were very prevalent, judging from the exhibits at Olympia, that type of receiver is now very much less popular. Although there are about 300 stands in the new hall we only noticed one firm that was showing a crystal set. Visitors interested in complete receivers rather than component parts or "kits," will find innumerable receivers at widely different prices. Some of these sets work without batteries, both the high-tension and low-tension supplies being derived from the electric light mains. It must not be imagined, however, that battery manufacturers are at present suffering any real hardship as the result of this system of operating wireless receivers. Innumerable high-tension batteries are on view. The high-tension dry battery still seems to be very popular, although quite a number of firms are exhibiting high-tension accumulators. Batteries composed of wet primary cells are also in evidence. Incidentally, the cartridge composed of two separate electrodes, *i.e.*, the sack and the zinc, is now supplied by the Standard Wet Battery Company as one complete component, which simply has to be placed in the jar, and a waxed cork prevents evaporation or spilling of the liquid.

There are many two-valve sets, some designed for battery operation, others for working off the mains; but the most popular set is the three-valve set, with a high-frequency valve, a detector, and a power valve. Some of these sets, however, have a detector and two low-frequency stages. Generally speaking, the sets with a high-frequency valve employ a shielded valve in the high frequency amplifier, because of the ease with which it may be arranged to provide good magnification with selectivity. Some of the three-valve receivers have a Pentode output valve, which gives greater volume than an ordinary power valve. The Philips receivers, designed for working entirely from the electric light mains, were among the most interesting receivers of the kind that came to our notice. The best and most expensive of these receivers has two screen grid high-frequency valves, a detector and Pentode valve. There is a single tuning control with a dial illuminated by a pilot light. The wave length ranges are from 200–600 and 1000–2000 metres. Provision is made for a gramophone pick up and there are output sockets for a moving coil loud speaker as well as for a cone type loud speaker.

It would be possible, if space allowed, to describe a very large number of new receivers shown at this Exhibition. Two new instruments are exhibited by

the Marconiphone Company, Ltd. One has three screen grid valves, a detector and a resistance-coupled low-frequency stage, and there are only two controls.

That receivers designed to work entirely off the electric light mains will eventually take the place of other receivers in places where an electric supply is available, is a fairly common opinion. These receivers are naturally a little more expensive than the battery type of receiver, but their advantages are very marked. The big demand for high and low-tension batteries that now exists is, of course, attributable to the fact that the "all-electric" set without batteries is, relatively speaking, new, and very large numbers of people purchased their sets before the idea of eliminating the batteries was put into practice. To some, the mains set may be regarded as a source of danger, but if it is properly designed there is little to worry about. Similarly there should be no danger with battery eliminators if they are properly constructed and installed. Owners of sets that work with batteries and who desire to change over to the mains system of supply will find at the Exhibition a good collection of apparatus for that purpose. Firms specialising in the manufacture of battery eliminators are Ferranti, Ltd., E. K. Cole, Ltd., the Edison Swan Electric Company, Ltd., the Igranic Electric Company, Ltd., and Radio Instruments, Ltd. Metal rectifiers for the construction of high and low-tension battery eliminators and battery chargers are shown by the Westinghouse Brake and Saxby Signal Company, Ltd. Incidentally, it may be mentioned that a rectifier of this type may be used to obtain a direct-current supply from alternating-current mains for feeding the pot magnet of a moving coil loud speaker. A rectifier unit giving the required output is used in conjunction with a suitable transformer, and as the inductance of the magnet winding is sufficient to keep the magnetisation constant it is unnecessary to employ a smoothing circuit.

For the first time, several important gramophone companies are exhibiting, and radio gramophones, incorporating the latest devices, are on view. A noteworthy feature of the Exhibition is that a large number of demonstration rooms has been provided on the gallery, and for the first time loud speaker demonstrations are being given by many of the exhibitors at intervals. Needless to say, there is a very large display of loud speakers, many of which give remarkably good reproduction. Some of them are constructed on more or less original lines. A new moving coil loud speaker exhibited by the Marconiphone Company, Ltd., has a special diaphragm of fibrous material very freely suspended, and is claimed to give improved balance of tone and greater sensitivity. The Celestion Company is showing for the first time a new moving coil loud speaker, which we understand is the outcome of many experiments. The quality of reproduction and power of the instrument are exceptionally good. In one of the demonstration rooms the Graham Amplion Company is demonstrating the performance of the Amplion Radio gramophone, and a selection of speakers operated by the Amplion Electravox pick-up or gramophone transmitter. The Amplion radio gramophone is operated entirely from the mains and comprises a standard Amplion radio set with a switch for long or short wave reception or gramophone operation, an electrically driven gramophone turntable, and a speaker with an 18in. cone diaphragm. In another room the General Electric is demonstrating the performance of its "Stork" cone loud speakers, and "Gecophone" moving coil loud speaker. Reproductions from gramophone records are being made by a "Gecophone" power amplifier. No fewer than twenty-four firms are showing their products in operation in demonstration rooms.

Radio accessories, such as tuning coils, chokes, condensers, intervalve transformers, resistance capacity coupling units, instruments, &c., are to be found in abundance. There are also, of course, many wireless "kits." All the components we examined were thoroughly well made. The workmanship of radio manufactures in these days is on the whole quite good, and the appearance of many modern receivers is pleasing.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

HOW DO CENTRIFUGAL PUMPS ACT?

SIR,—With reference to the question raised by Mr. G. Ure-Reid in the May 3rd, 1929, issue of THE ENGINEER, regarding centrifugal pumps, it appears that in his interpretation of the inflow velocities certain facts have been lost sight of and the following explanation may be in order:—

On the basis of the generally accepted theory it is true, as Mr. Ure-Reid points out, that the entrance diagram as indicated in Fig. 1 theoretically will change from triangle A C B to triangle A c B as the radial velocity, which is a direct measure of the quantity, is reduced from the value f to $f/2$. For both cases the value of the vane entrance angle α will remain theoretically the same and the relative velocity will vary approximately as the radial velocity or quantity. Internal whirl, friction, &c., will, of course, distort these diagrams somewhat, but basically the variation should be about as indicated.

Mr. Ure-Reid contends that such a change in the entrance diagram cannot take place, stating that with a known value of peripheral speed and radial velocity the path of the water within the impeller is fixed in such a manner that the relative velocity must remain approximately constant for all quantities until the impeller runs full. This condition might well be true if the direction of the absolute velocity at entrance remained fixed as the quantity is varied and if no diffusion takes place within the impeller vanes. Actually, the direction of absolute velocity at entrance changes, and as the quantity is reduced the direction of this velocity becomes more nearly horizontal in the direction of impeller rotation. This change in direction of the entering water is evident from the increased whirl which is established as the quantity is reduced.

At zero flow the absolute velocity, neglecting friction, &c., will theoretically become equal to and parallel with the linear speed of the impeller, and it should be evident from this that under this condition the relative velocity must necessarily be reduced to zero. For any intermediate value of flow the relative velocity should vary in proportion.

In the application of Mr. Ure-Reid's method for plotting the path of flow within the impeller, the difference between the impeller speed and the tangential or whirl component of the absolute entering velocity and not the impeller

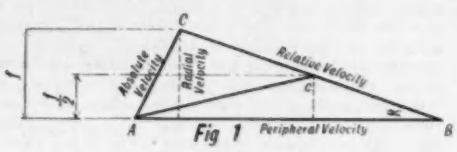


Fig 1

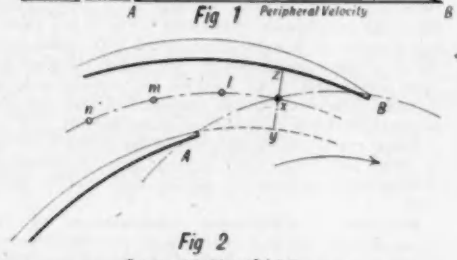


Fig 2

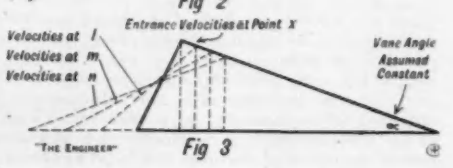


Fig 3

speed alone should be used in the determination of the travel time from point A to point B, Fig. 2. Mr. Ure-Reid has evidently used the absolute linear velocity of the impeller u_1 alone for this computation, which is obviously incorrect.

In regard to the velocity conditions within the impeller, it is incorrect to assume that the relative velocity at entrance will always be equal to the relative velocity within the impeller. The entrance diagram indicates only the average velocity conditions in the water at point of entrance x, Fig. 2, over the section $y - z$ and does not apply for any point within the impeller. When considering a point within the impeller it should be understood that the linear speed of the impeller u_1 changes directly as the radius, f will change inversely as the circumferential area and the vane angle α may also change. On this basis the velocity conditions of the water passing through the impeller may vary diagrammatically in about the manner indicated in Fig. 3 at the points l, m, n located in Fig. 2. A gradual change in relative velocity may result.

If, then, the effect of the whirl in the water at the entrance to the impeller is clearly understood, and if the relative velocity within the impeller at the point or points to be considered is correctly computed in the manner above outlined, the discrepancies indicated in Mr. Ure-Reid's analyses would disappear. JAS. B. CUTLER.

Baltimore, Md., September 11th.

RATIONALISATION AND TECHNICAL STAFFS.

SIR,—In these days of rationalisation one must, it is presumed, prepare for many changes. Of late, one frequently hears of the amalgamation of a group of engineering firms of long standing, with the consequent closing down of a certain number of their works. In many cases these works are of world renown, and the workpeople and staff have been engaged there many years.

Employment, it is stated, will be found for a few at one or other of the new firm's works, probably 50 to 100 miles away. The older workmen who are unable to uproot themselves and families from what is often a life-long residence and association with that district, are suddenly bereft of means of livelihood, while the remainder to whom no offer of employment is made become recipients of the "dole."

The technical staff, works engineers, managers, designers, draughtsmen, &c., are placed in an even worse plight by the sudden stoppage of their work, for in the majority of cases they are not qualified to obtain unemployment benefit.

Many of these men have worked up to their present positions by giving years of faithful service, by hard study and perseverance. They have never at any time been in receipt of sufficient remuneration to provide a margin to withstand any long period of unemployment. Their plight appears hopeless, and, believe me, Sir, there are some very despondent engineers in Sheffield to-day, who are faced with the loss of their homes, and can see nothing in front of them but starvation by the closing down of certain Yorkshire firms!

And, our technical schools and engineering colleges are turning out their hundreds to swell the ever-increasing army of "out-of-work" engineers!

Surely *Punch's* famous advice would be sound to any young man who has an engineering career in mind as a means of earning a livelihood.

ALFRED J. HUMPHREYS.

Sheffield, September 19th.

THE PHYSICAL DIMENSIONS OF TEMPERATURE.

SIR,—In Mr. F. C. Johansen's paper on "Research in Mechanical Engineering by Small-scale Apparatus," which appears in the last issue of the "Proceedings" of the Institution of Mechanical Engineers, the author states that "temperature cannot, in the present state of knowledge, be expressed by a combination of the fundamental units of mass, length and time." During the discussion in London the same view that temperature is dimensionless was expressed by Professor Gilbert Cook, and I know that both gentlemen can claim the support of a well-known book of reference.

With all respect to such authorities, I would point out that, according to the kinetic theory of gases, temperature (absolute) is proportional to the mean kinetic energy of the molecules, so that temperature would seem necessarily to have the same dimensions as energy.

To reason more precisely, consider first the well-known gas equation $C_p - C_v = R$. Dividing throughout by the number of molecules concerned, this may be written $c_p - c_v = k$, where k is the universal gas constant referred to a single molecule. Now, as Professor Cook rightly observed, a specific heat is "simply a ratio, requiring no units in its statement." It follows, then, that k is also simply a ratio, with no dimensions. Again, by the kinetic theory of gases—see Ewing's "Thermodynamics"—it is proved that $P = \frac{m N v^{-2}}{3}$, P being the pressure, N the number of molecules per cubic centimetre, m the mass of each molecule, and v^{-2} the mean square velocity of the molecules. Writing $V = \frac{1}{N}$ as the volume per molecule, we have $\frac{P}{N} = PV = \frac{m v^{-2}}{3}$. But, since the equation of state $PV = RT$ becomes $PV = kT$ when referred to a single molecule, we have $PV = kT = \frac{m v^{-2}}{3}$. As k has no dimensions, it follows therefore that temperature must have the same dimensions as work or energy.

September 18th. $M.L^2.T.^{-2}$.

AIRSHIP "R 101."

SIR,—I fear your reference to the oil-burning engines in the airship "R 101" may be misunderstood, in the sense that the limitations mentioned have been set up by using heavy oil, involving heavier weight and loss of power.

It would take too long to go into detail through all that has happened, but it might be sufficient to say that the burning problem—that is, of heavy oil at high speed—was satisfactorily accomplished over four years ago, and it is the selection of the type of engine and the drive that is accountable for the limitations. The engine is low-speed, direct-coupled, and the reversible air screw, originally intended, is not now being used. If the engines were developed more on the lines of the standard air engine, say, twelve cylinders "V" type geared, the saving in weight would be very great, and the question of power, which you mention, would not arise.

Even this letter may not make the situation clear, but as the one responsible for the oil burning, I feel that to let it go by without raising some issue would be unfortunate, as the gain in safety from the use of heavy oil in airships is so great that for the general world to think that this can only be done by foregoing many other advantages, would be, at any rate at this stage, very unfortunate.

ALAN E. L. CHORLTON.

London, S.W. 1, September 23rd.

AGE-HARDENING OF ALUMINIUM.

THE Aeronautical Research Committee has just published a report on "The Age-Hardening of Some Aluminium Alloys," by Marie L. V. Gayler, D.Sc., and G. D. Preston, B.A. The work was performed for the Engineering Research Board of the Department of Scientific and Industrial Research, and the report is obtainable from H.M. Stationery Office, price 2s.

A brief summary of the contents is given below.

The following physical properties of five physical aluminium alloys containing copper, magnesium silicide or both have been examined under similar conditions of heat-treatment so that further light may be thrown on the mechanism of age-hardening. (1) Brinell hardness; (2) tensile strength; (3) density; (4) electrical conductivity; (5) changes in the crystals, as determined by X-ray analysis.

It is shown that the changes in density and in lattice parameter, which take place during ageing suggest that

precipitation from solid solution takes place. X-ray analysis shows also that the crystals themselves are in a disturbed state, which is gradually relieved by further ageing at high temperatures. The increase in electrical resistance on ageing corresponds to this distortion of the space lattice of the solid solution, caused by the presence of minute particles due to the decomposition of the solid solution.

It has been inferred that the precipitation from solid solution entails two processes:—(1) The rejection of the atoms of the dissolved metal from the lattice of the solid solution accompanied by the possible formation of molecules, (2) a "coagulation" of these rejected atoms or molecules takes place, a process which follows closely upon the first and probably largely overlaps it. The reporters consider that the evidence given may be regarded as strong confirmation of the theory that hardening is due to the precipitation of highly-dispersed articles.

LAUNCHES AND TRIAL TRIPS.

LINDENBANK, steamer; built by Workman, Clark (1928), Ltd., to the order of Messrs. Andrew Weir and Co.; dimensions, 436ft. by 56ft. by 36ft. 3in.; to carry cargo. Engines, quadruple-expansion, 22in., 32in., 46½in., 68in. by 48in. stroke, pressure 260 lb. per square inch; constructed by the builders; launch, September 6th.

SIDI-BEL-ABBES, twin-screw steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Société Generale de Transports Maritimes à Vapeur; dimensions, 383ft. by 50ft.; to carry passengers. Engines, two sets of single-reduction geared turbines of the Parsons type; constructed by the builders; launch, September 5th.

ARDANBEAM, steel screw cargo steamer; built by D. and W. Henderson and Co., Ltd., to the order of Messrs. Clark and Service, Glasgow; dimensions, 403ft. by 52ft. by 29ft. 10in. Engines, triple-expansion, 21½in., 37in., 62in. by 42in. stroke, pressure 220 lb. per square inch; constructed by the builders; launch, September 6th.

IRWIN, twin-screw steamer; built by D. and W. Henderson and Co., Ltd., to the order of the South Indian Railway Company; dimensions, 250ft. by 38ft. by 12ft.; to carry passengers and cargo. Engines, two geared turbines and water-tube boilers; constructed by Yarrow and Co., Ltd.; launched recently.

EDUCATIONAL INTELLIGENCE.

THE session 1929–30 opens at University College, London, on Monday, October 7th. The Department of Municipal Engineering has been reorganised as the Department of Municipal Engineering and Hygiene. It has been provided with increased laboratory accommodation. Dr. M. E. Delafield has been appointed Special Lecturer in Hygiene. Among the public lectures that have been arranged for the first term are three lectures by Mr. E. T. Elbourne, M.B.E., on "Engineering Management," on Tuesdays, November 12th, 19th, and 26th, at 6.30 p.m., and a lecture by Colonel D. C. Cameron, O.B.E., on "Some Administrative Difficulties of Mechanisation," on Tuesday, November 19th, at 5.30 p.m. Particulars of these and other public lectures may be had on application to the Secretary, University College, London, W.C. 1. A stamped addressed envelope should be enclosed.

HIGH-PRESSURE STEAM VALVES FOR THE KEARSLEY POWER STATION.—Messrs. J. Blakeborough and Sons, Ltd., Brighouse (Yorks.), ask us to call attention to the fact that the flanges of the high-pressure steam valve supplied by them for the Kearsley Power Station of the Lancashire Electric Power Company were machined to the Aiton patent "Corwell" particulars.

TRADE EXHIBITION, BUENOS AIRES.—An Empire Trade Exhibition in Buenos Aires is now being organised for six weeks during February, March, and April, 1931. This project has been initiated by the British Chamber of Commerce in Buenos Aires, and Anglo-Argentine interests, both at home and abroad, have given it their strong support, and, in addition, have subscribed substantial guarantees. The object is to place British trade with Argentina more on a par with British purchases and investments there; to demonstrate not only to Argentina, but also to all South America, that British initiative, British goods, and British salesmanship, backed by British credit, so far from declining, are preparing to reach higher levels than ever before. The Argentine Rural Society—the most important organisation in Argentina—has shown its sympathy with the Exhibition project in a very practical way, by placing at its disposal, free of charge, the grounds and permanent buildings of the Society. With regard to the Empire side, the Dominion of Canada has already agreed on the space necessary for a large and representative Canadian exhibit, and other Dominions and Colonies are being approached. His Majesty's Government is represented on the London Executive Committee of the Exhibition through the Board of Trade Exhibition Department, and will announce its plans at a later date.

THE INSTITUTE OF TRANSPORT.—The following premiums in respect of the session 1928–29 have been awarded by the Council of the Institute of Transport:—Institute Triennial Gold Medal: To Mr. Robert Bell, C.B.E., for his papers on (i.) "Trade and Transport Prospects on the North-East Coast," (ii.) "Transport Developments in 1928." Railway (Operating) Gold Medal: Donor, the Railway Companies' Association; to Brigadier-General F. D. Hammond, C.B.E., D.S.O., for his paper on "Some Transport Problems of the Empire." Railway (Engineering) Gold Medal: Donor, the Railway Companies' Association; to Mr. H. N. Gresley, C.B.E., for his paper on "The Froelich Hydraulic Wagon Brake at March Concentration Yard." Road Transport Gold Medal: Donor, the Commercial Motor Users Association; to Monsieur A. Metral, for his paper on "Fuels: Alternative or Supplementary to Petrol for Road Vehicles Fitted with Internal Combustion Engines—Gaseous Fuels." Road Transport Gold Medal: Donor, the Underground Railways and L.G.O.C. Group; to Dr. W. R. Ormandy for his paper on "Fuels: Alternative or Supplementary to Petrol for Road Vehicles Fitted with Internal Combustion Engines—Liquid Fuels." Water Transport Gold Medal: Donor, the Dock and Harbour Authorities Association; to Mr. J. F. R. Wiggins for his thesis on "The Labourage Policies of Port Authorities." Institute Graduate Silver Medal: To Mr. A. A. Jackson for his essay on "The Sphere of the Rail-less Trolley Vehicle System." Institute Student Silver Medal: To Mr. A. F. Chandler for his essay on "The Principle of the Standard Net Railway Revenue." *Modern Transport* Premium: Donor, *Modern Transport*; to Mr. E. Wallis (graduate), for his essay on "Junction Lay-outs."

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Position.

THERE has been only a medium amount of business in iron and steel transacted this week in the Midlands and Staffordshire. Consumers would undoubtedly have purchased more had they been permitted to do so by manufacturers, but the latter, anticipating a rise in selling values declined to do business at recent rates. The weekly meeting of the iron trade in Birmingham to-day—Thursday—was well attended, and the result of the meeting of the Pig Iron Producers' Association, which had under discussion the question of raw iron prices, was awaited with interest. Steel prices having been settled for the time being, producers were on the look out for buyers, and some good business was reported to have been done and to be pending. The autumn demand is, however, slow to develop, and work in several of the consuming industries is irregular. The export demand for manufactured goods is said to show a more marked improvement than the home demand, especially so far as certain goods are concerned. With competition keen and production costs high, manufacturers are having to submit to very narrow profits. Iron and steelmasters on 'Change to-day spoke quite optimistically of the prospects for the remainder of the year, as did many engineers, including those in the structural branch. Automobile engineers and concerns engaged in light engineering work in Staffordshire and the Midlands continue moderately active, and report the outlook as fairly bright. The tube trade in this area remains steadily employed, though one or two sections of the trade are not so well placed as they were. Once raw iron prices are settled, business in all branches of the market is expected to forge ahead.

Raw Iron Prices.

The market has this week been anxiously awaiting clarity in the pig iron department. Forge and foundrymen and other users of raw iron realising that an advance in selling prices was almost inevitable, pressed smelters to accept orders at recent rates. Blast-furnacemen, however, would not consider entering into forward contracts or renewing existing ones until the decision of their Association regarding price revision was made known. In a few cases they were prepared to supply customers' current needs, but even so they demanded premiums varying from 1s. 6d. to 2s. per ton. This did not deter merchants and users from buying, and they booked as many tons as furnacemen were prepared to supply. As a speculation, much more iron would have been secured if smelters would have let it go. Iron production costs continue to increase, for coke, which is difficult to obtain, is now making 17s. 6d. per ton at ovens. Nor can furnacemen see any prospect of a betterment of the position. More furnaces are being brought into action month by month, and the winter demand for fuel for domestic purposes is almost at hand. It looks very much as if furnacemen will, in the near future, have to pay still more for coke for smelting purposes. To compensate themselves they will need to secure better prices for their iron. The difficulty in which smelters find themselves is well recognised, and hardly a doubt is entertained that, at the monthly meeting of the Central Pig Iron Producers' Association to-day, the official minimum prices will be further advanced even though producers are naturally concerned as to the effect of rising costs on home demand and are anxious not to put obstacles in the way of export business. In this latter connection it is interesting to note that last month we exported nearly five tons of pig iron to every ton imported. Nevertheless imports of foreign foundry grade pig are on the increase, 5125 tons being imported last month, as compared with 3232 tons in July. Pig iron production must be kept on a profitable level, and it is difficult to see how that is to be brought about without advancing selling prices. There is no surplus production in this area, and little or no stocks of iron, but furnaces are able to cope with the larger demands now being made upon them. Foundry grade iron is in brisk demand, and more attention is being paid to forge iron than for some time past. Specifications continue on a good scale, and many contracts are now due for renewal. Next week should witness the placing of some large orders at the prices fixed at to-day's meeting of smelters. It seems unlikely that business will be withheld, for there are little prospects of a fall in prices for some time to come, and consumers will be anxious to insure ample supplies to meet their needs over the next three months. The foundries in this district are actively engaged at the moment, and are reported to have good prospects so that, in their case, at any rate, there should be no hesitation about entering into contracts for pig iron supplies for some time forward.

Coke Values.

The position with regard to blast-furnace coke is becoming increasingly stringent, and little is to be had on the open market. Prices, which have been gradually stiffening for some time, have now reached 17s. 6d. per ton at ovens. With three more furnaces to supply than a month ago, and the winter domestic calls to be met, any relief from the present scarcity is not anticipated, and a continuance of the present high level of prices is probable.

Welcome News.

Contrary to the expectations of many manufacturers but in fulfilment of the hopes of most, the Steel Association last week end announced that there would be no change in finished steel prices for the time being. Although production costs have increased since prices were last revised, the Association came to the conclusion that it would be inexpedient to attempt to pass on the increase to the consumer. Its action should stimulate buying, and its attitude towards prices and business is generally commended. Price stability is undoubtedly one of the most important factors in encouraging enterprise and inducing those concerned in the building of important structures to put the work in hand. It is to be hoped steelmasters will be rewarded by increased turnover for their commendable decision. Angles and joists now stand at £8 2s. 6d. per ton; tees at £9 2s. 6d.; ship, bridge and tank plates at £8 17s. 6d. Buyers who use British steel exclusively, and they include the major portion of Midland buyers, receive rebates of 12s. 6d. per ton on joists and 10s. per ton on other defined materials. Boiler plates stand at £9 12s. 6d., and steel hoops at £10. The consumption of heavy steel recently has been heavier, and a fair amount of buying has taken place in anticipation of the probable rise in prices. There is still a good deal of room for improvement in the local constructional engineering establishments, the yards being far from fully occupied. Structural business in the South Staffordshire district is said to be more finely cut than in most other parts of the country, and profits are extremely lean. Numbers of small contracts are being given out, and inquiries are more plentiful. Prices in the half products branch of the market show little change. Foreign semis are firmer in price, but in no better demand. Native billets make £6 10s., and Welsh billets £6 7s. 6d. The works could do with more orders, but employment is reasonably good. Continental 2in. billets are offered at £5 15s. delivered, steel bars at £6 15s., and tube strip at £7 2s. 6d.

Finished Iron.

No concerted move has so far been made by Staffordshire bar iron makers to advance prices on the strength of the appreciation of pig iron, but such action at any time would occasion no surprise. The demand for Staffordshire marked bars is well sustained, and makers have no difficulty in getting the official price of £12 per ton. Some of the mills have work on the books sufficient to see them through this year at the present rate of production. They, in common with other users of pig iron, are concerned as to the effect of advancing costs on their ability to produce finished iron at prices which will give them a chance of competing for business abroad. Crown iron demand maintains the improvement recently noted. Competition is keen and prices well below the £10 asked by local makers are acceptable to sellers in other districts. There is a small output of nut and bolt bars at £9 per ton, but the greater part of the material used in local works is from Belgium and costs £6 15s. per ton. Nut and bolt makers who use steel as the basis product are also using foreign material. Wrought iron tube strip at £11 2s. 6d. per ton is not in quite such good request as recently. Continental merchants are selling tube strip at £7 2s. 6d. per ton, and a fair tonnage of this material is coming into the district.

Galvanised Sheets.

Substantial overseas buying of galvanised sheets is still delayed, and the home demand is insufficient to keep the mills fully employed. India, usually a very good market, is not buying to any extent, and mill users are expressing some concern as to the immediate future. Prices of 24-gauge galvanised corrugated sheets are unchanged, most makers asking £13 7s. 6d. per ton. It is possible here and there to get an order accepted at slightly less. Black sheets are somewhat quiet at the moment.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

New and Prospective Business.

ENGINEERING interests in Lancashire expect to receive a fair share of the work that will be created by the £2,850,000 development and modernisation programme of the London, Midland and Scottish Railway Company, an outline of which was issued at the beginning of this week. The general assumption is, although no official statement to this effect has been made, that the order for thirty Garratt locomotives to the value of £300,000 will be placed with Beyer, Peacock and Co., Ltd., Gorton, Manchester, who already have good order books, a number of important overseas contracts having been placed with the firm during recent months. An interview with an official of the company on Tuesday, however, was successful only in so far that it elicited the information that nothing was known regarding the L.M.S. order. Lancashire firms are hopeful of benefiting also through orders for other types of locomotives, and in connection with bridge reconstruction work and the extension of the coal-handling plant at the port of Garston. The Manchester Corporation Tramways Committee on Tuesday of this week placed orders to the value of about £100,000 for motor omnibuses. The tenders of Crossley Motors, Ltd., Manchester, Leyland Motors, Ltd., Leyland, near Preston, and the Associated Equipment Company, Ltd., London, were accepted for thirty chassis each. Orders for the body work are being distributed among various companies.

Public Works Schemes.

The Manchester Unemployment Relief Works Committee has had under consideration this week a number of schemes which, it is suggested, should be carried out, and has recommended that the City Council should make application for a Government grant towards the cost. This is estimated at about £500,000, the items relating for the most part to road construction, many of them being of a minor character individually, although several of them relate to more imposing schemes. With a similar object in view, Salford City Council has adopted a number of improvement schemes, involving a total expenditure of about £95,000 and the local authorities at Rainford, near Ormskirk, have accepted a sewerage scheme for the township at an estimated cost of £21,000.

Manchester's Waterless Gasholder.

The construction of a waterless gasholder by R. and J. Dempster, Ltd., Newton Heath, Manchester, at a cost of £56,000, is now in progress at the Bradford-

road gasworks of the Manchester Corporation, and an official visit of inspection by members of the Gas Committee was undertaken a day or two ago. The holder, which will have a capacity of 5,000,000 cubic feet of gas, will, it is claimed, be the largest of its kind in the country, having a height of about 250ft., and is said to be unique also in that its base is to serve as the roof of a stores and fitters' shops.

An Elevator in Tow.

Built by J. Crichton and Sons, Saltney, near Chester, to the order of the United Grain Elevator Company, Liverpool, a grain elevator towed by three tugboats started out on Sunday on its journey from Messrs. Crichton's shipbuilding yard at Saltney, along the river Dee, to Liverpool. The elevator is of the pneumatic type and has a displacement of 600 tons and a grain discharging capacity of 250 tons an hour.

The Finance of Engineering.

Although not yet back to the dividend-paying stage, a marked improvement in conditions is reflected in the report of the directors of Kendall and Gent (1920), Ltd., machine tool manufacturers, of Gorton, Manchester. During the last twelve months, it is stated, the orders placed with the company were 50 per cent. more than in the year 1927–28, and a net profit of £2006 was made, compared with a net loss in the previous year of £539. More than £8000 worth of new machinery was added to the plant account. A reduced dividend on the ordinary shares for the year ended June 30th last is being paid by Dobson and Barlow, Ltd., textile machinists, of Bolton. An interim dividend of 3 per cent. was paid earlier on, making with the final distribution of 6 per cent. now announced a total of 9 per cent. for the year, against 10 per cent. in each of the four previous years.

Non-ferrous Metals.

A week of markedly steady to firm conditions in the markets for non-ferrous metals has been in evidence. The period has not been without its fluctuations, but on balance copper is slightly dearer and both tin and lead have been maintained at the improved levels of the previous week. There has been a slight loss in spelter, which has brought prices current at the moment of writing down to where they were at the beginning of the month. The demand for standard brands of copper during the past week has not been at all active, and in the case of refined descriptions also the movement has been on very moderate lines. In the tin section of the market speculative interest in the metal has been lying more or less dormant and the trade demand likewise has been on the quiet side. Tin values may be able to retain their steadiness within reasonable limits, but in view of the now heavy stocks at British ports, any marked advance for the time being seems to be unlikely. There has been a moderate demand about in the case of lead, and present prices are round about the levels of a week ago. Although spelter is cheaper only to the extent of about 1s. a ton, the outlook is not too certain and supplies of the metal are more than sufficient to meet the demand.

Iron and Steel.

Far from any evidence of an easier trend in the foundry iron market, conditions ruling at the moment seem to point to higher prices being decided upon by Staffordshire, Derbyshire and other Midland counties producers of the metal before the week is out. So strongly held was this view among sellers early in the week that offers were virtually withdrawn except at a premium, and even then there was no great disposition to sell far ahead. Steady deliveries of foundry iron are being made to consumers' works in Lancashire, and on the whole there seems to be little sign of these slowing down. Pending any changes that may take place later in the week, prices current at the time of writing, so far as Midland brands are concerned, are largely nominal at the fixed prices quoted a week ago. Bar iron values are firmly maintained in spite of the fact that the demand in this section is still on a relatively restricted scale. Crown quality bars are quoted by Lancashire makers at £10 15s. per ton and No. 2 quality at £9 15s. After a slight spurt in new steel buying during last week as a safeguard against a possible rise in prices, business has only been moderate, although rollers have little cause for undue complaint with regard to delivery specifications. Locomotive engineers keep fairly busy and some, though not all, of the constructional engineering firms in this district have good order books. Small re-rolled bars are held at from £8 5s. to £8 7s. 6d. per ton, with large bars at £9 2s. 6d., boiler plates at £9 17s. 6d., tank plates at £8 17s. 6d., and sections and joists at £8 2s. 6d. The market for foreign materials is uncertain in tendency and only a small business has been reported here this week.

A New Capital Power Station.

In a paragraph in your "Seven-day Journal" last week reference is made to the two new capital power stations, Hams Hall and Portishead, which are about to be put into service. Another capital station which has been completed for some time, but has been waiting for a load before being started up, is the new Slacks Valley Station belonging to the Oldham Corporation, which will be officially opened on October 15th. For design this station will be found to compare very favourably with any in the country. It will have finally a capacity of about 150,000 kW, but when started up next month it will contain three 12,500-kW turbo-alternator sets, by Metropolitan-Vickers Electrical Company. These will run at 3000 revolutions per minute and will generate three-phase current at 50 periods and 6600 volts. The boiler plant will consist of eight B. and W. water-tube boilers, each capable of evaporating 50,000 lb. of water per hour. The working pressure will be 295 lb. per square inch and the final temperature of the steam will be 700 deg. Fah. The Slacks Valley Station is admirably situated for supplies of coal and water, and an unusual feature of the water cooling towers will be the use of filtered sewage effluent for make-up purposes. This will be obtained from the Corporation's sewage works close by. Mr. Robert Blackmore is chiefly responsible for the design of this fine station.

BARROW-IN-FURNESS.

Hematite.

There is quite a healthy tone in the hematite pig iron market, and, generally speaking, producers are well fixed for orders for some time ahead. In some cases they are booked well into next year. If the steel trade was only in a better condition there is no doubt that there would have to be an increase in the number of furnaces. The home trade is strong and promises to remain in that condition. Special qualities are in good demand and business with the Continent and America is promising. The iron ore trade is steady, with a slightly better tone owing to better business with users outside this district. The local demand is steady, but is not likely to improve to any extent unless more furnaces are put into blast. Foreign ore importations are well maintained. The steel trade is dull and few orders are available. The Barrow mills are restarting, but the number of contracts held at present does not assure them of a long run. The hoop mills are well placed and are mostly engaged on orders on overseas account.

SHEFFIELD.

(From our own Correspondent.)

Condition of the Steel Industry.

In ordinary lines of steel, trade can only be described as bad. The production of acid steel continues to be on a very low level and the bulk of the output in the Sheffield district is of steel of basic quality. Most of the rolling mills and forges are on short time owing to the poor demand which prevails for anything but special steels. The latter still provide the brightest feature of the general position, and firms making specialities are doing well and have good prospects. Stainless steel, for instance, is in good demand, the trade expanding with several substantial orders recently booked. There has been a slight improvement in railway work, both from the home companies and from overseas, but the position is far from satisfactory. Tool steels have declined a little, manufacturers having to face extremely keen competition. Nevertheless there continues to be an optimistic tone in the industry as a whole and there are hopes of a general revival in trade within the next month or so.

Rolling Stock Orders.

Railway work recently placed includes an order obtained by Craven's Railway Carriage and Wagon Company, Sheffield, for the construction of four third-class passenger coaches for the Rhodesia Railways. Amongst other orders placed are those for 100 quintuple bolster wagons, each of 40 tons capacity, for the London and North-Eastern Railway, three locomotives for the Kowloon-Canton Railway, screw couplings for the Indian State Railways, and twenty-five covered wagons for the Sudan Government Railways. All this work has not come to Sheffield, but there is no doubt that works are a little busier than they have been for a considerable period. The rail mill at Stocksbridge is now working regularly.

The Lighter Trades.

So far there has been no response to the appeal of Mr. W. C. Veall, of Sheffield Cutlery Manufacturers, Ltd., for steps to be taken to devise a scheme for the rationalisation of the cutlery industry in the Sheffield district. Indifference to the suggestion and doubts as to its practicability are expressed by local manufacturers. Conditions in the trade are "patchy," a few firms having good order books while others are very short of work. Steamship companies have recently taken large quantities of best quality cutlery and the cheap bazaars are taking heavy consignments of stainless knives. There is a satisfactory demand for engineers', mechanics' and stone-working tools, but manufacturers of files are experiencing a very lean time, and the demand for agricultural and garden tools is quiet.

Aswan Dam Contract.

Mr. Charles Boot, chairman and managing director of the firm of Henry Boot and Sons, Ltd., public works contractors, Sheffield, has left for Egypt in order personally to deposit a tender for the work which the Egyptian Government is to undertake for heightening the Aswan Dam across the Nile. The total cost of the work will reach about £3,895,000, including a large expenditure for iron and steel work in the sluice gates, &c., and the contractors' plant alone will cost over £400,000. Mr. Boot is hoping to secure the whole of this work and also, if possible, orders for about 100,000 tons of cement for British works. The dam, which is 1¼ miles long, has 180 steel sluice gates. The dam was opened in 1902 and in 1912 it was made higher, so that the storage capacity of the reservoir was increased from 1000 to 2400 million cubic metres. It is now intended to heighten the dam for the second time, thus raising the level of the water by about 35ft., and more than doubling the capacity. In addition to the heightening, the dam will be thickened by the building of buttresses on the downstream side, between the sluices. There will be differences of expansion between the old work and the new, and, in order to allow movement of the new work on the face of the old dam, the old face will be dressed and a specially made non-corrosive metal sheet, ¼in. thick, will be placed between the two faces. About 1000 tons of this material will be required. The total amount of masonry in the new dam will be about 400,000 cubic metres. For this, with the exception of the cement, there is plenty of material in the vicinity of Aswan.

Yorkshire Work Schemes.

In connection with schemes for the relief of unemployment, the Bradford Corporation has submitted to the Ministry of Transport plans for bridge and road building at a total cost of about £400,000. One of the most important projects is the Harrogate Road scheme, which involves the erection of a new bridge over the river Aire at a cost of £40,000 at Apperley Bridge, and the removal of the very dangerous corner on the Bradford-Harrogate road. Application is to be made to the Ministry for sanction for the borrowing power necessary and the Government grant.

Trolley Omnibuses for Trams.

Sheffield has particular interest in the announcement that the Nottingham Tramways Committee is asking the City Council to promote a Bill in the next session of Parliament to obtain powers for the conversion of all its tram routes into trolley omnibus routes. Several routes have already been converted, and it is proposed to deal with the others by easy stages. There is a tendency for similar action to be taken in other parts of the country, and Sheffield manufacturers of tramway trackwork and rails are feeling the effect. Sheffield Corporation has just erected, at a cost of about £100,000, a new depôt for trams and a large omnibus garage, the two being combined in a building of unusual design situated in Townhead-street. In this building advantage was taken of the slope of the ground to form the tramcar depôt on the lower level and the omnibus garage on the upper level.

Big Excavator Combination.

Negotiations are nearing completion whereby Ruston and Hornsby, Ltd., of Lincoln, manufacturers of excavating machinery, oil engines, boilers, pumps, &c., will join with the Bucyrus-Erie Company of South Milwaukee, who have works at South Milwaukee, Erie and Evansville, in the formation of a new company to be known as Ruston-Bucyrus, Ltd., with works and head offices at Lincoln, to specialise in the manufacture of excavating machinery. The contribution of Ruston and Hornsby, Ltd., to Ruston-Bucyrus, Ltd., will be the firm's excavator business, including the whole of the excavator works and organisation. Bucyrus-Erie Company, Ltd., will contribute an equivalent value in cash and will transfer to the new company the whole of its interests in countries outside North and South America, Japan and China. Provision has been made for the maintenance of equality of capital holding and directorate representation of the respective companies. The first directors of the new company will be Col. Joseph Seward Ruston, George R. Sharpley, John H. W. Pawlyn, Victor W. Bone, Lieut.-Col. P. D. Ionides, Sir Archibald Ross, Roger W. Newberry, and William W. Coleman. Mr. Coleman, who is president and chairman of the board of Bucyrus-Erie, will be chairman of the board; Col. Ruston, chairman of the board of Ruston and Hornsby, Ltd., will be vice-chairman; Mr. Victor Bone, now director of works of Ruston and Hornsby, Ltd., will be managing director; and Mr. Newberry, now manager of foreign sales of Bucyrus-Erie Company, will be director of sales. According to present plans, the new company will commence operations on January 1st, 1930.

NORTH OF ENGLAND.

(From our own Correspondent.)

Ironstone Miners' Wage Claim.

The Cleveland Miners' Association has formulated wage claims which, if granted, will involve an increase to every class of worker employed in and about the mines. Under the present system the men are paid a fixed base rate plus a sliding scale percentage—which at present stands at 56¼—based on the average realised selling price of No. 3 Cleveland G.M.B. pig iron. The miners' proposal is that of the additional percentage one quarter shall be merged in the base rates, leaving the balance of the percentage to operate on the higher base rates. It is estimated that the claims if granted would mean an addition of about £20,000 a year to the wage bill in the Cleveland mines. An increase in the special rates of pay for work in hot places is also being sought, and a claim has been advanced for a general increase in the wages of datal men engaged in the Weardale limestone quarries.

Cleveland Iron Trade.

The Cleveland iron trade presents a much brighter appearance. Inquiries are more numerous, and in some cases they are coming from quarters with which Cleveland has not recently been doing business. The autumn buying movement appears to have begun in real earnest, and iron producers are in no anxiety regarding the disposal of their output to the end of the year. Prompt iron is very scarce, and as prospective requirements are heavy consumers are deeming it prudent to place substantial forward contracts. Prices are now very firm. Costs have advanced substantially and far exceed any benefits under de-rating. Hence there is no hope of a fall in quotations, and consequently no inducement to delay purchases. The export trade is quiet, but home needs are sufficient to absorb the output, and fixed minimum prices remain unchanged as follows:—No. 1 Cleveland foundry, 75s.; No. 3 G.M.B., 72s. 6d.; No. 4 foundry, 71s. 6d.; and No. 4 forge, 71s.

Hematite Pig Iron.

The position in the East Coast hematite pig iron trade is causing much anxiety to producers in consequence of the rising cost of production. An early material advance in quotations is essential. They are gradually moving in that direction, but orders are still unobtainable, except at rates that entail loss of several shillings per ton to producers. There are makers who refuse to accept current rates, and are stocking iron rather than sell on the unremunerative terms consumers are prepared to pay. Home and continental consumers are in the market at figures recently taken, but they appear to be disinclined to follow a substantial advance. As no agreement fixing prices exists, quotations vary. Ordinary qualities are in the neighbourhood of 76s. 6d., and No. 1 grade of iron is at a premium of 6d. per ton.

Ironmaking Materials.

There is little new business being done in the foreign ore trade. Consumers have long contracts arranged

and are not at all disposed to negotiate further supplies, while merchants are not in a position to make heavy sales except for delivery well ahead. Nominally market rates remain on the basis of best Rubio at 24s. 6d. c.i.f. Tees. Notwithstanding the forthcoming enlargement of output of Durham blast-furnace coke, scarcity of that commodity threatens to become more acute. For good average qualities sellers are asking up to 23s. 6d. delivered at North-East Coast works.

Manufactured Iron and Steel.

Active conditions are still maintained in the manufactured iron and steel trade. Finished iron makers keep exceptionally busy, and booking a few orders. Low prices named for continental semi-finished steel are checking business with producers in this area, but makers are well sold. Finished steel makers are turning out heavy tonnage. Specifications for shipbuilding requisites are being distributed freely, and material for constructional purposes is well taken up. Quotations for all descriptions of manufactured iron and steel are steady.

Steel Order for Tees-side.

The Tees-side Bridge and Engineering Company, Ltd., Middlesbrough, has secured the contract for the manufacture and galvanising of the whole of the steel structural work for the Mid-East England electricity scheme. About 6000 tons of steel is involved in the contract, and the work will chiefly consist of latticed-galvanised steel towers.

The Coal Trade.

Inquiry from abroad is expanding for nearly all classes of fuel, and there are several noteworthy contracts pending. Most of them are for considerable quantities, and in one or two instances they are of the large seasonal kind. So far as tonnage and wagon supply is concerned, the position is certainly more satisfactory than it was a week ago. Less time is being lost at the collieries, though the better supply of tonnage has not enabled the Durham pits to secure full late prices for their second grade coals for prompt lots, and buyers in a position to take immediate delivery may obtain slight concessions. Superior qualities of both Northumberland and Durham coal reveal no weakness, and fitters are willing to do business at only current quotations. The strong demand from all quarters for best steam coals has placed these grades in an enviable position, while current inquiry ensures a market for every ton of coal that can be raised between now and the end of the year. Northumberland and Durham during the last few months have been successful against Polish competitors in Scandinavian markets, and in most contracts for large supplies that have been placed the two counties have secured a considerably larger proportion than have Polish shippers. In Denmark, however, Poland is still a formidable rival. For the remainder of this year competition from abroad need hardly concern fitters in respect of best grades of fuel. They are so well sold as to have been obliged, in instances, to be chary in accepting new business because of their already heavy commitments. Superior qualities of Northumberland steam coal continue the best feature of the market, and cannot be obtained under 16s., while forward they tend to strength to 16s. 3d., and as much as 16s. 6d. Tyne primes are firm and unchanged at 15s. 6d. to 15s. 9d. Gas coal is showing a better demand and is restricted only by tonnage shortage. Best brands are fairly well taken up at 16s. 9d. to 17s., and at 17s. to 17s. 6d. for specials. Bunkers are a quiet trade, and are in good supply for prompt. Ordinary qualities are unchanged at nominal figures of 15s. 6d. to 15s. 9d., with specials bringing a steady 17s. to 17s. 6d. Coke requirements are extraordinarily heavy just now, and producers are very comfortably situated for trade, both prompt and forward. Quotations are firmly upheld. Ordinary foundry coke keeps to 25s., gas coke at 22s. 6d. to 23s., and special foundry cokes range from 28s. to 32s. 6d.

SCOTLAND.

(From our own Correspondent.)

No Change.

NOTHING of outstanding interest has occurred in the Scottish steel, iron or coal trades during the past week. Business as a rule has proceeded on recent lines and prices generally are unchanged.

Steel.

Employment in the heavy steel industry is comparatively good, and though the higher costs which may have to be met cause some concern, makers on the whole take a fairly optimistic view of the immediate future. Local and North of Ireland shipyards are taking steady deliveries and there seems no reason to expect an early reduction in demand. The position with regard to steel sheets continues to improve, and it is said that it is now practically normal, the home demand having strengthened and stocks held in Eastern markets appreciably reduced.

Tubes.

The position in the tube trade is satisfactory on the whole, though one or two works principally interested in the export trade are working short time. The market may probably be affected to some extent in view of the tube cartel meeting to be held at Vienna, but as no drastic alterations are expected business will in all probability soon reassume recent standards.

Wagon Contract.

The London and North-Eastern Railway Company has just placed an order with R. Y. Pickering and Co., Ltd., Wishaw, for 40-ton capacity bogie bolster wagons, which will provide employment for a large number of men for a considerable period.

Iron.

Business in bar iron is dull and there is no likelihood of an early improvement. Prospects have been further clouded by a regrettable falling off in Canadian demands. Steel re-rollers continue to be affected by the cheapness of continental small bars. Local re-rolled steel bars are quoted about £8 home and £7 15s. per ton export. Pig iron is a very quiet market, the restricted output being ample to meet all demands. Prices are unchanged, quotations being controlled.

Scrap.

The turnover in scrap is moderate, but available supplies are easily disposed of. Heavy steel is quoted 77s. 6d., cast iron machinery 70s., and heavy basic, which is relatively scarce, 72s. 6d. per ton.

Coal.

The market for practically all qualities of Scottish fuel for shipment remains firm. Lanarkshire splints and ells and Fifeshire steams, especially the last named, being the strongest feature among large coal. Collieries in the Lothians have fair quantities available for prompt shipment. Second quality Lanarkshire round coal is rather more plentiful. In all districts washed nuts are a strong market. Aggregate shipments amounted to 281,608 tons, against 292,885 in the preceding week and 240,269 tons in the same week last year. Home sales, however, have not expanded as anticipated, and the collieries find considerable difficulty in obtaining the higher prices indicated a week or two ago, representing an increase of from 1s. to 1s. 6d. per ton. Shippers on the East Coast view with some concern the possibility of a shortage in small tonnage through the decision to send pig iron to Scotland —under the De-rating Act—by rail instead of by steamer, as tonnage required to load coal for North France, Yarmouth and the Thames may thereby become scarce and freights increased.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

SCARCELY any change has been perceptible in the general conditions prevailing in the steam coal trade during the past week. Comparative quietness has been the feature so far as the demand for early shipment is concerned. Buyers show no anxiety to operate for shipment during the next few weeks, though there is the satisfaction that interest is well maintained in supplies for delivery over next year. Following upon arrangements made for substantial quantities for South American railways and for the well-known French shipping undertaking, Cie Générale Transatlantique, for steam coals over 1930 comes the news that another French shipping firm—Chargeurs Réunis—is in the market for about 40,000 tons, consisting of two-thirds large and one-third small for delivery over next year, while the French military authorities at Cherbourg are inquiring for prices for 10,000 tons of sized coals. The trouble of most collieries, however, continues to be more immediate, and the paucity of demand, more especially for large coals, is so pronounced that stoppages of work are numerous. Unfortunately, interruption of working is more than temporary in some directions, as, for instance, in the Monmouthshire area, where, on account of the depression in trade, work has had to cease altogether at some pits and notices to terminate contracts have been served on other miners. In the Abertillery district three collieries are already closed down until further notice, and 500 miners at the Vivian Colliery have received notices to terminate contracts, so that this will leave only one pit, the Cwmtillery Colliery, working in that area. Most of the collieries producing Admiralty coals in other areas are working well, and it is really surprising that shipments of coal from South Wales as a whole are so good, taking into consideration the fact that tonnage supplies are inadequate. The lack of prompt demand for large coals throws into relief the inquiry for smalls and sized descriptions. In order to fulfil their contracts it is reported that some collieries have resorted to the breaking of large coals in order to produce sufficient sized and small coals to carry out their obligations. This is quite an unusual procedure in this district so far as steam qualities are concerned.

Coals for Canada.

Considerable interest has been displayed in this area in the recent visit of Mr. J. H. Thomas, the Minister of Employment, to Canada, and much speculation exists as to its possible benefit to South Wales so far as the coal trade is concerned. It is, of course, well known that, so far as anthracite coals are concerned, trade with Canada is on well-established lines, largely owing to the initiative and energy of Mr. H. H. Merrett, of Gueret, Llewellyn and Merrett, Ltd., of Cardiff. From accounts now to hand it is considered that there is still scope for further expansion in anthracite coal exports, but the purpose of Mr. Thomas's visit to Canada was to foster trade generally, and he and his experts have apparently investigated very thoroughly the prospects of exports of steam coals. In fact, prior to his leaving England he arranged for the dispatch to Canada for trial purposes of 1000 tons of Monmouthshire coal. Last year America sent to Canada 13,822,000 tons of steam and bituminous coals. Much of it, of course, was sent to areas which, as conditions are, do not permit of this country entering into competition; but it is pointed out that between 2,000,000 and 3,000,000 tons go to Montreal and points to the east of Montreal which ocean tonnage can reach and which therefore give a chance to British coals to compete. It cannot, of course, be expected that Canada should pay more for British coals than for those she is now taking, and according to one leading authority who accompanied Mr. Thomas to Canada, an examination of the prices now paid shows that British coals could be offered to Canadian consumers to compete with American coals, provided that the outward freight rate for coals from this country ranged from 6s. to 7s. per ton. Therein, however, is the difficulty. In past years freight rates on cargoes of Welsh coals to Montreal or Quebec have ruled about 6s. 6d. to 7s. per ton, but during the current year shippers of anthracite have had no little difficulty in getting their full tonnage requirements at even 8s. to 8s. 6d. per ton owing to the fact that the homeward market for grain cargoes has been so poor and unsatisfactory. The question is, can outward rates for coal be in any way stabilised at anything like a level that will permit of shippers undertaking contracts for British coal, thus eliminating or minimising the risk of possible heavy losses through freight rates going against them? There is no doubt manifest willingness on the part of Canadians to improve trade with this country, as shown by the fact that the Canadian Pacific Railway is prepared to purchase 100,000 tons of British steam coal, provided the price is satisfactory—an important condition. The fact is not overlooked that Nova Scotia has an important coalfield and does substantial business with Canada, and Canada can scarcely be asked to assist British coals at the expense of Nova Scotia. The suggestion, however, was put forward that as Nova Scotian coals contain from 30 to 35 per cent. volatile matter and 8 to 13 per cent. ash much could be done possibly by mixing these coals with Welsh or other British coal to produce a fuel that will give increased steam-raising properties.

Warning to Miners.

The President and Secretary of the South Wales Miners' Industrial Union have issued a manifesto to the workers in the coalfield which is not calculated to reduce the hostility of the South Wales Miners' Federation. The manifesto states that the time has arrived when notices will be given to terminate the present agreement and when the men will again be asked by the leaders of the South Wales Miners' Federation to fight on another empty slogan. In 1929 another great slogan is being coined, "A national agreement or nothing," and the men are appealed to not to be gulled again as in 1921 and 1926. The experiences of past years have taught them that the Miners' Federation has allowed agreements to terminate before taking steps to secure a new agreement, which has meant driving foreign contracts to other countries owing to the insecurity of our own markets.

Mining Science.

The Powell Duffryn Steam Coal Company, Ltd., which has probably done more to advance mining science than any other colliery company in this country, opened its new School of Mining at Britannia, Bargoed, last week, when Mr. D. A. Hann, joint general manager of the company, presided at the gathering and explained that the object of the school was to keep in closer touch with the students of the respective county councils and provide them with greater facilities for practical training than are at present available. It was also pointed out that it was not intended to supplant what was now being done in such an admirable manner by the Glamorgan and Monmouthshire County Councils.

Current Business.

The tone of the steam coal market is quiet, large coals particularly being short of prompt orders. This makes for the scarcity of sized and small coals owing to irregular working, and these qualities are firm. Gas coal prices for inland sale have been advanced from 1s. to 1s. 6d. per ton, and it is probable that from October 1st the minimum prices for all house coals will be raised. Coke is firmer and patent fuel steady, while pitwood rules about 32s. to 33s.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

GASIFIED PULVERISED FUEL (G.P.F.), Ltd., of Canada House, 4–5, Norfolk-street, Strand, London, W.C. 2, asks us to announce that it has acquired the goodwill and business of the Holbeck Engineering Company, previously operated by Messrs. Fraser and Chalmers Engineering Works, of Erith.

THE SUPERHEATER COMPANY, Ltd., asks us to announce that on Monday, September 30th, its offices will be transferred from 195, Strand, to Bush House (7th Floor, East Wing), Aldwych, London, W.C. 2, and requests that all future correspondence should be directed to the latter address. Its telegraphic and cable addresses will remain as before, i.e., "Supertemp, Phone, London," and "Supurtemp, London," respectively; but its new telephone number will be "Temple Bar 3263 (4 lines)."

CONTRACTS.

RUTHS STEAM STORAGE, Ltd., of Africa House, Kingsway, London, W.C. 2, has received an order from Ferguson Brothers, Ltd., for a steam accumulator to be installed at the latter's Holme Head Works, Carlisle.

THOMAS ROBINSON AND SON, Ltd., of Rochdale, have received an order for the installation of their vacuum dust-collecting system in the workshops of the Benguela Railway, West Africa, the wood-working section of which is equipped with this firm's machinery.

MARCONI'S WIRELESS TELEGRAPH COMPANY, Ltd., has received an order for a large extension of the Polish broadcasting organisation, which, following the English example, is to be remodelled so as to provide alternative programmes for the greater part of the country. The new equipment will comprise one 120-kW aerial input broadcasting transmitter with full modulation, two high power regional stations with 16-kW aerial input, and three local relay stations. The 120-kW station will be situated near Warsaw, and the two new 16-kW stations will be at Lemberg and Vilna respectively.

BOVING AND CO., Ltd., have received an order for a 60,000 B.H.P. water turbine plant from the Hidroelectrica Iberica, Spain. The head under which the plant is to work is 345 metres and the speed of each of the two units is 428 r.p.m., the turbines being of the Pelton type. The same firm has also received an order for two vertical shaft Francis type turbines for the New Zealand Government's development at Waitaki. Each turbine will have an output of 23,000 B.H.P. at 125 r.p.m., on a head of 70ft. The wheels of these turbines will have an overall diameter of 13ft. 6in., and will thus, it is claimed, be the largest ever built in Great Britain.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/6 to 22/–
(1) Spanish	24/– to 25/–
(1) N. African	24/– to 25/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	24/9

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 0 0	—
No. 1 Foundry	3 18 6	—
No. 3 Foundry	3 16 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 16 6	3 16 6
No. 1	3 17 0	3 17 0
Cleveland—		
No. 1	3 15 0	3 15 0
Silicious Iron	3 15 0	3 15 0
No. 3 G.M.B.	3 12 6	3 12 6
No. 4 Foundry	3 11 6	3 11 6
No. 4 Forge	3 11 0	3 11 0
Mottled	3 10 6	3 10 6
White	3 10 6	3 10 6
MIDLANDS—		
(3) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	—*	—
" " Foundry	—*	—
(3) Northampton—		
Foundry No. 3	—*	—
Forge	—*	—
(1) Derbyshire—		
No. 3 Foundry	—*	—
Forge	—*	—
(3) Lincolnshire—		
No. 3 Foundry	3 12 6	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 5 6 (*a*) / 4 7 6 (*b*) / 4 11 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 15 0	—
Second Quality Bars	9 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	9 0 0 to 9 5 0	—
Gas Tube Strip	11 2 6	—

STEEL (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
" " (Land)	10 0 0	10 0 0
Ship Plates, ⅜in. and up	8 12 6	7 12 6
Sections	8 2 6	7 2 6
Steel Sheets, ⅛in.	9 0 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	13 10 0	13 7 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 12 6	—
Angles	8 2 6	—
Boiler Plates (Marine)	10 10 0	—
" " (Land)	10 0 0	—
Joists	8 2 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	9 2 6	—
" (Small Round)	8 5 0 to 8 7 6	—
Hoops (Baling)	10 0 0	9 15 0
" (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
" (Lancs. Boiler)	9 17 6	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	7 0 0	—
Hoops	9 15 0 to 10 5 0	—
Soft Wire Rods	8 0 0	—
MIDLANDS—		
Small Rolled Bars	8 5 0 to 8 15 0	—
Billets and Sheet Bars	6 10 0 to 6 15 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 7 6 to 13 10 0	—
Angles	8 2 6	—
Joists	8 2 6	—
Tees	9 2 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/7½ to 18/9
Block Tin (cash)	205 7 6
" " (three months)	209 5 0
Copper (cash)	74 6 3
" (three months)	74 15 0
Spanish lead (cash)	23 13 9
" " (three months)	23 12 6
Spelter (cash)	24 0 0
" (three months)	24 5 0
MANCHESTER—	
Copper, Best Selected Ingots	80 10 0
" Electrolytic	85 0 0
" Strong Sheets	110 0 0
" Tubes (Basis Price), lb.	0 1 3
Brass Tubes (Basis Price), lb.	0 1 1
" Condenser, lb.	0 1 3
Lead, English	25 2 6
" Foreign	23 15 0
Spelter	24 7 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	3/6½ per lb.	
Ferro Tungsten	3/3½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	7/6
" " 6 p.c. to 8 p.c.	£22 10 0	7/–
" " 8 p.c. to 10 p.c.	£22 0 0	6/6
" " Specially refined		
" " Max. 2 p.c. carbon	£33 0 0	12/–
" " " 1 p.c. carbon	£38 0 0	15/–
" " " 0·70 p.c. carbon	£42 0 0	17/–
" " " carbon free	1/2 per lb.	
Metallic Chromium	2/6 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home	
	£13 10 0 for export	
" Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/– per unit	
" " 75 p.c.	£19 10 0 scale 6/– per unit	
" Vanadium	13/– per lb.	
" Molybdenum	4/– per lb.	
" Titanium (carbon free)	11d. per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/4 per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/–
" " Ell	15/9
" " Splint	16/6 to 18/–
" " Trebles	16/– to 16/6
" " Doubles	15/6
" " Singles	13/– to 13/6
AYRSHIRE	
(f.o.b. Ports)—Steam	13/6
" " Jewel	16/–
" " Trebles	16/6
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	12/6 to 15/6
Screened Navigation	17/6 to 18/6
Trebles	17/6
Doubles	16/–
Singles	13/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	14/–
Secondary Steam	13/6
Trebles	17/–
Doubles	16/–
Singles	13/6

ENGLAND.

	Inland.	Export.
(8) N.W. COAST—		
Steams		21/6 to 22/–
Household		38/– to 51/–
Coke		26/6 to 27/6
NORTHUMBERLAND—		
Best Steams		16/– to 16/6
Second Steams		14/6 to 14/9
Steam Smalls		10/– to 10/6
Unscreened		13/– to 13/6
Household		21/– to 26/–
DURHAM—		
Best Gas		17/–
Second		15/6 to 16/–
Household		21/– to 27/–
Foundry Coke		25/– to 30/–
SHEFFIELD		
Best Hand-picked Branch	26/6 to 28/–	—
Derbyshire Best Bright House	21/– to 23/–	—
Best House Coal	20/6 to 21/6	—
Screened House Coal	18/6 to 20/–	—
" " Nuts	16/6 to 18/–	—
Yorkshire Hards	15/6 to 17/–	—
Derbyshire Hards	15/6 to 17/–	—
Rough Slacks	9/– to 10/–	—
Nutty Slacks	7/– to 8/–	—
Smalls	3/– to 5/–	—
Blast-furnace Coke (Inland)	14/6 at ovens	—
Furnace and Foundry Coke (Export), f.o.b.		23/– to 24/–

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	19/9 to 20/–
Second Smokeless Large	19/6 to 19/9
Best Dry Large	18/9 to 19/–
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/– to 18/3
Western Valley Large	17/9 to 18/–
Best Eastern Valley Large	17/9 to 18/–
Ordinary Eastern Valley Large	17/3 to 17/9
Best Steam Smalls	13/9 to 14/6
Ordinary Smalls	12/6 to 13/–
Washed Nuts	17/6 to 20/–
No. 3 Rhondda Large	20/– to 21/–
" " Smalls	15/6 to 16/–
No. 2 " Large	17/– to 17/6
" " Through	15/6 to 16/6
" " Smalls	14/3 to 14/9
Foundry Coke (Export)	30/– to 37/–
Furnace Coke (Export)	27/6 to 30/–
Patent Fuel	21/6
Pitwood (ex ship)	32/– to 33/–
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	34/– to 37/6
Seconds	28/6 to 30/6
Red Vein	24/– to 27/6
Machine-made Cobbles	40/– to 44/–
Nuts	40/– to 45/–
Beans	23/6 to 25/6
Peas	19/– to 19/6
Breaker Duff	9/9 to 10/–
Rubbly Culm	11/3 to 11/9
Steam Coals:	
Large	18/– to 19/–
Seconds	17/– to 18/
Smalls	11/3 to 13/–
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum) 12/6 Ordinary Ship, Bridge and Tank Plates and Sections 10/– if home consumers confine purchases from associated British Steel Makers. * Under revision as we go to press.

French Engineering Notes.

(From our Correspondent in Paris.)

Inventions.

THE annual exhibition of "small inventors," which was instituted twenty-seven years ago by the then Prefect of Police, Monsieur Lépine, with a view to enable artisans and others to bring their discoveries to the public notice, does not appear to have done much in the way of stimulating invention, and the exhibition is being used more for the sale of articles in daily use. The only notable stand was that showing the inventions of the late Fernand Forest, who is credited with having built the first multi-cylinder petrol engine for motor vehicles, and of being the precursor of many of the features of engine design. He appears to have been the first to employ fins for air cooling, and his inventive genius covered the whole field of petrol engine construction.

Apprenticeship.

The only thing that added interest to the exhibition of small inventors was the section devoted to the work of apprentices. The old system of shop apprenticeship has entirely disappeared, mainly as the result of social legislation, but also on account of the reluctance of youths to serve an apprenticeship when they can earn good money right away in factories equipped with machinery for mass production. There has long been some doubt whether the replacing of shop apprenticeship by "professional" schools is a good thing for industry. The instruction in such schools has become highly developed. In nearly all branches of industry the makers' associations have established schools in which craftsmanship is thoroughly taught, and at the exhibition there were some particularly good exhibits of the work of apprentices in the army and navy apprenticeship schools as well as in those of the railway companies. The training lasts three years, and nothing could be better than the work of the apprentices as regards finish and precision, while the forged iron and other ornamental metal work showed a high degree of merit.

Port Extensions.

The programme of harbour works to be continued in the coming year provides for an expenditure of about 5000 million francs, one half of which was to have been contributed by Germany in the form of material on account of reparations, but as under the new arrangement at the Hague the reparations are to be considerably reduced this programme, as well as all the other public works' schemes, will be seriously hampered unless some way is found of making up for the deficiency. The Minister of Finance is therefore considering the means of continuing the various programmes and preventing what would otherwise be a serious dislocation of the engineering and other industries which depend largely upon the contracts being given out for public works. More is probably being done in improving shipping facilities than in any other branch of economic activity. All the ports without exception are being extended and more suitably equipped. At Dunkirk a new outer port is to be constructed, and at Boulogne it is proposed to reserve the existing basins for the fishing industry and to construct a vast outer port for commercial shipping and as a port of call for Transatlantic steamers. Havre is to be converted into what is declared to be one of the largest ports in the world by the construction of new basins and an outer breakwater, and extensive dredging will be undertaken to allow of the biggest ships entering and leaving at all tides instead of being obliged, as at present, to wait for high water. The latest traffic returns place Rouen first in the list of ports, a little ahead of Marseilles, and the principal work being undertaken there is the deepening of the Seine for ships drawing 8 m. of water. It is remarked that when that costly work is completed it may be found insufficient in view of the tendency nowadays to build much larger cargo boats. A deep water landing stage is being constructed at Cherbourg to permit of Transatlantic steamers drawing up alongside, and elaborate arrangements are being made to provide the port with every facility for dealing with ocean traffic. Brest will soon be able to receive cargo boats, and Saint-Nazaire is carrying out works to permit of the construction of the largest Transatlantic steamers. The Compagnie Transatlantique has already ordered a vessel having dimensions and an estimated speed which, it is expected, will enable it to compete with the "blue ribbon" ships of other countries. La Rochelle-Pallice is to become the great port for the South American and African traffic. The canal between Marseilles and the Rhone is so far advanced that there is already communication between Marseilles and the Etang de Berre. The old Port-Vendres, near the Spanish frontier, which was abandoned on account of rocky obstructions, has been resuscitated, and during the past week a service with North Africa, which has the advantage of providing a shorter and more sheltered course along the coast of Spain, has been instituted.

Tropical Condensers.

At the Congrès de l'Eau, which was held at Algiers about two years ago, a good deal of attention was given to experiments that had been carried out with methods of condensing water from hot air by contact with the cool internal surfaces of thick walled stone or concrete constructions. It is stated that a cubic metre of saturated air at 30 deg. Cent. loses thirteen grammes of water by condensation at a temperature of 20 deg. Cent. A French engineer, Monsieur Knapen, has built several types of condensers in the form of square and circular towers and some dome-shaped with the internal surfaces roughened with angles and points to facilitate condensation. Monsieur Knapen declares that a hundred square metres of surface will condense as much as 50,000 litres of water a day in tropical climates where the air is in a fairly high state of saturation.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

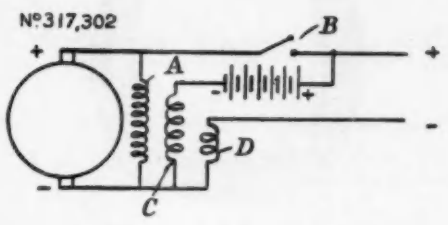
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

317,302. February 13th, 1928.—VOLTAGE REGULATORS FOR ELECTRIC GENERATORS, Ben Sykes, of Royal Aircraft Establishment, South Farnborough, Hampshire.

When the generator described in this specification is started, the shunt field A is excited and the generator voltage rises until the contacts of the battery cut-out B close. Charging current then flows to the battery through the coil C, which tends to demagnetise the field of the generator and thus prevent any further material rise of voltage. The line voltage is thus automatically

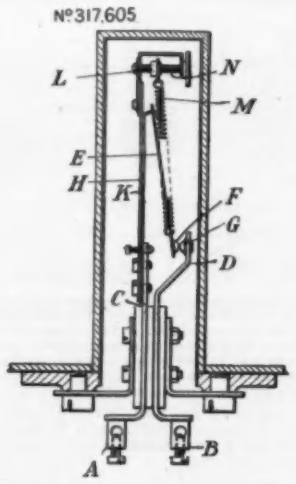


maintained at approximately battery voltage. The series winding D is arranged to assist the field, so that on load variation a smaller fluctuation of battery current is required in C to maintain the necessary field strength. By suitably designing the field windings of the generator the line voltage and battery current variation on change of speed or load can be made as small as desired. When the generator output falls owing to loss of speed the battery is free to supply load current through the coils C and D which can be made of low resistance.—*August 13th*, 1929.

SWITCHGEAR.

317,605. July 11th, 1928.—THERMALLY-OPERATED ELECTRIC SWITCHES, The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C. 2; and Henry Cobden Turner and Arthur Sherwin, both of Salford Electrical Instruments, Ltd., Peel Works, Silk-street, Salford.

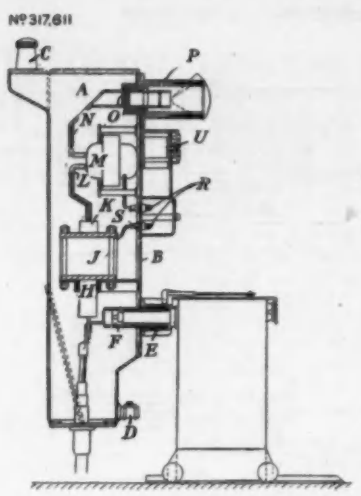
The circuit to be controlled is connected to the terminals A B on the strips C and D. When the member E is in the position shown there is an electrical connection from the terminal A to terminal B through the strips, member E, moving contact F, fixed contact G and strip D. When the temperature of the switch rises the strip H flexes towards the left and the strip K



flexes towards the right, since the high expansion faces of these strips are in contact with one another. Finally the nut L and the top end of the spring M are carried so far to the left, and the top end of the member E is carried so far to the right that the member E passes the dead centre position and springs to the left, thus interrupting the electrical connection between terminals A and B. Regulation of the temperature at which the switch opens is effected by varying the position of the nut L by turning the screw N, as this varies the amount of the flexure of strips H and K required to carry the member E across the dead centre.—*August 22nd*, 1929.

317,611. July 17th, 1928.—ELECTRICAL SWITCHGEAR, Theodore Christian Christianson, of 8, Westwood-avenue, Timperley, Manchester; and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, in the City of Westminster.

The stationary portion of switchgear of the type described in this specification comprises a tank A having a detachable front plate B. At the top of the tank there is a filler hole C and cap, together with a level indicator, whereby it may be filled with oil. A drain cock D is provided at the bottom. In the lower part of the detachable front plate a spout E and plug and socket contacts F are provided for the connection of a potential transformer. The end of the plug and socket connection within the tank is connected to one terminal H of the primary of a current transformer J for the operation of protective gear for circuits associated with the switchgear. The other terminal K of the primary winding of the current transformer J is connected to one terminal L of the primary winding of a second current transformer M for the operation of measuring instruments. The second terminal N of the primary winding of the latter current transformer is connected to the socket of a plug and socket contact O within a spout P which is mounted upon the detachable front plate B, by means of which electrical connection may be made to the separable or draw-out portion of the switchgear. The two current transformers are mounted one above the other on the detachable plate B and their secondary terminals R are also mounted on the detachable plate by means of insulating bush-

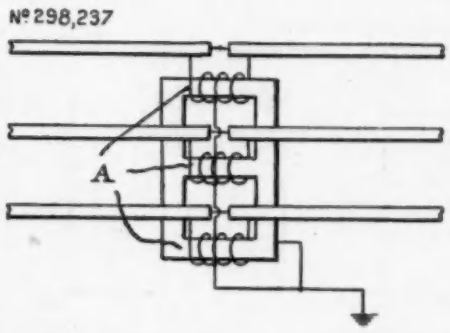


ings S or other form of mounting. Auxiliary plug and socket connections U, connected with the current transformer, for example, may also be mounted upon the detachable plate B.—*August 22nd*, 1929.

TRANSMISSION OF POWER.

298,237. October 5th, 1928.—METHODS OF AND MEANS FOR BONDING TOGETHER ELECTRIC CABLE SHEATHS, Herman Halperin and Kenneth William Miller, both of 72, West Adams-street, Chicago.

This specification describes a method of bonding electric cable sheaths in a multi-phase transmission system and consists in separating the sheaths into lengths electrically insulated from each other and bridging the insulating joints of the sheaths by

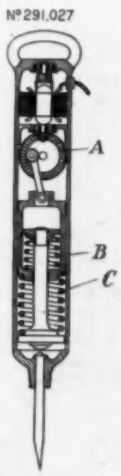


reactance coils A, the coils being connected so as to cause the magnetic fluxes to act in opposition. With reactances constructed as shown, returning fault currents flowing back over the sheaths of the three cables are nearly equal in amount and phase on each sheath and in the same direction through all the coils of the reactor. This results in flux opposition in the iron core so that there is practically no voltage drop in the coils owing to the returning fault current.—*August 22nd*, 1929.

MACHINE TOOLS AND SHOP APPLIANCES.

291,027. May 17th, 1927.—ELECTRO-MECHANICAL HAMMERS, *Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.*

When the bevel wheel A is rotated by means of the electric motor, a reciprocating motion is imparted to the carriage by means of the crank and connecting-rod. If the carriage moves towards the motor then the drawing-back spring B is compressed and the percussion spring C is released. Shortly before the end of the movement of the carriage, which is retarded towards the end, the drawing-back spring is unloaded by the movement of the hammer block and imparts to the hammer block an additional acceleration in the direction towards the motor. By this acceleration of the hammer block a certain pre-tension is imparted to the percussion spring C. By means of the succeeding movement of the carriage towards the percussion side the percussion spring is further tensioned and simultaneously the hammer block is compelled to reverse. Shortly before the termination of the carriage motion in the direction of percussion, which is retarded towards the end, the percussion spring is released and imparts to the hammer block an additional acceleration in the direction of the percussion. At the moment when the hammer block has acquired its highest velocity it imparts its energy of motion by percussion to the tool. The arrangement is claimed to result in a material increase of the percussive effect of the hammer while the back percussion on the hands of the operator is considerably diminished.—*August 19th*, 1929.

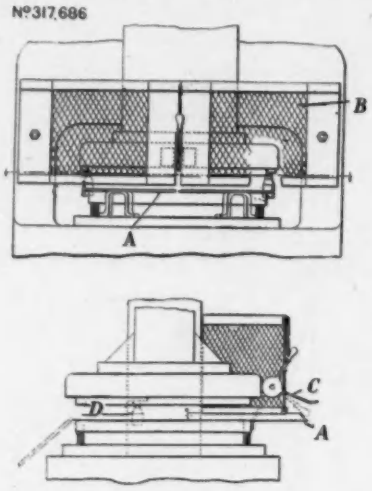


317,686. November 17th, 1928.—FEED GEAR FOR POWER PRESSES, J. H. Roberts, 395, Upton-lane, Farnworth, Widnes, Lancs.; and Imperial Chemical Industries, Ltd., Millbank, London, S.W. 1.

This invention aims at the protection of the operator of a power press against injury to his hands in placing the blanks in

position. The press is consequently provided with a light table A in front of the pressing dies, on which the blanks are placed. This table is in front of a fixed guard B. The blanks are pushed under the guard into the pressing position by means of the

No 317,686



trigger-like contrivance C, and are positioned against telescopic stops D. These stops are so spaced that they will arrest the blank, but will permit its passage when it has been pressed to the desired form, as the next blank is pushed into place.—*August 22nd*, 1929.

MEASURING AND TESTING INSTRUMENTS.

294,666. July 28th, 1928.—ALTERNATING-CURRENT METERS, *International General Electric Company, Inc., of* 120, *Broadway, New York.*

The load curve, dependent on the strength of the current in alternating-current meters, is adversely influenced when the load is small, by the magnetic properties of the iron. This influence can be reduced by providing as great an air gap as possible for the magnetic lines of force of the iron core of the current coil. The magnetic resistance of the air then pre-

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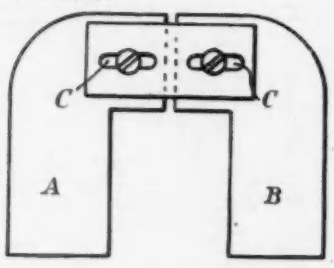

dominates with regard to that of the iron. By this means, a good proportionality is guaranteed between the load current and the flux generated, since the permeability of the air is constant. The current coil core of an alternating-current meter constructed in accordance with this invention, consists of two parts A and B, which are held together by means of a tie piece provided with slots. The tie piece is attached to the core by screws, and the C slots permit adjustment of the air gap. Owing to the fact that each current core is made of two parts, it is possible to wind the two parts separately.—*August 29th*, 1929.

318,075. January 7th, 1929.—DIRECT-CURRENT ELECTRICAL MEASURING INSTRUMENTS, George Edward Lloyd, of 8, Portnall-road, London, W. 9, and Electrofio Meters Company, Ltd., of Abbey-road, Park Royal, London, N.W. 10.

This invention relates to direct-current electrical measuring instruments of the moving coil type, in which the sensibility to electric current is made variable. A is the permanent magnet of a moving coil instrument having pole pieces B and a central

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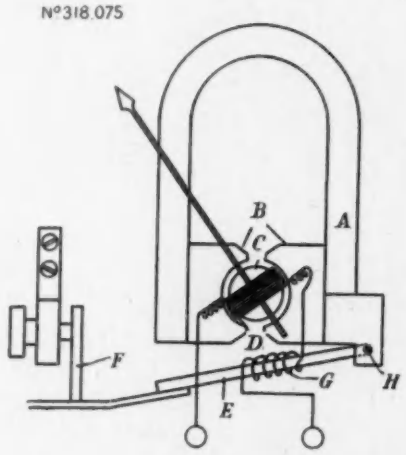


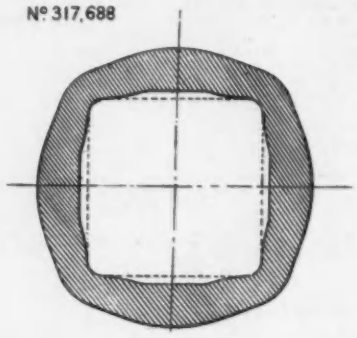
core C, around which rotates the pivoted or suspended moving coil D. A magnetic shunt E pivoted at H may be moved relatively to the magnet by means of the cam F, so as to alter the sensibility of the instrument. The winding G on the magnetic shunt is connected in series with the moving coil, and, when the magnetic shunt moves, it has an electromotive force induced in it, which neutralises the deflecting effect due to induced electromotive forces in the moving coil.—*August* 29th, 1929.

METALLURGY.

317,688. November 21st, 1928.—INGOT MOULDS, E. Gathmann, 4720, Edmondson-avenue, Baltimore, Maryland, U.S.A.

The inventor says that an ingot cast in a vertical mould having a uniformly corrugated dodecagon or twelve-sided cross-sectional chamber contour is subject to the formation of fewer surface flaws or defects during solidification than any other form of ingot heretofore known. An ingot of this type, however, in common with other substantially round or oval cross sections, is more or less difficult to handle in the rolling mill, and if properly reduced requires a greater number of initial mill passes than are necessary in the reduction of an ingot of substantially rectangular cross section of the same maximum cross sectional dimension in order to ensure against tearing of the outer structure at the corner portions of the ingot. According to the invention, an ingot mould is formed with a chamber comprising four primary side walls, four outwardly arched corner walls, and eight secondary walls merging with the primary side walls and the corner walls, the secondary walls having an inwardly bellied contour. The chords across each secondary wall may

No 317,688



extend at an angle of from 5 deg. to 15 deg. with the adjacent primary side wall, each of which side walls is preferably substantially straight and parallel to its oppositely disposed primary side wall. A metallic ingot, obtained from a mould constructed in accordance with this invention has four substantially straight oppositely arranged side walls and four outwardly arched corner walls connected to the primary walls by inwardly bellied walls. By the present invention the type of surface solidification characteristic of ingots of the dodecagon type cross section is obtained, at the same time retaining the advantages of an ingot of rectangular cross section in reduction of the section during rolling mill operations. The type of mould made in accordance with the invention has approximately 22 per cent. greater volume for a given maximum dimension of ingot than has the dodecagon type of ingot cross section at present widely used so that it is possible materially to increase the tonnage of blooms or billets that may be reduced to specified size in a given number of passes. The drawing reproduced is only one of several accompanying the specification.—*August 22nd*, 1929.

MISCELLANEOUS.

317,704. March 5th, 1929.—SELF-ACTING AIR ESCAPE VALVES, R. A. Blakeborough and T. B. Blakeborough, Brighouse, Yorks.

This air escape valve, which is intended for service on water mains, is of that type in which a ball float A seals the opening of the escape passage B when it floats upwards against a rubber

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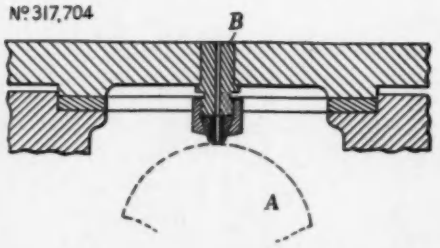

nipple. It is suggested that, with the usual constructions, there is a liability for the orifice of the nipple to be closed permanently in the process of fixation in the main. The inventors consequently make the nipple with a core of comparatively hard material and a sheath of soft rubber which extends sufficiently far to provide a seating for the float ball. The several parts are assembled by a screw cap as shown.—*August 22nd*, 1929.

317,702. December 29th, 1928.—STUFFING-BOX PACKINGS, G. Huhn, 23, Letevzowstrasse, Berlin, Germany.

This stuffing-box is put forward as being especially suitable

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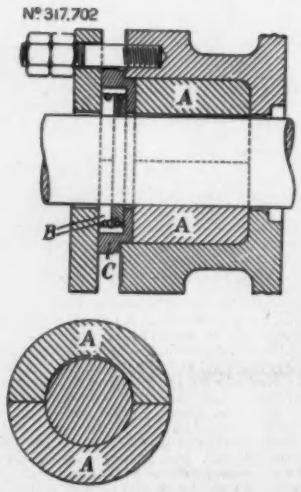

for locomotive work, but it does not appear quite clear as to whether the inventor is aiming principally at steam-tightness or at the guidance of the piston-rod. He fills up the major part of the box with the cast iron packing pieces A A, which are a good fit on the rod round the lower half of the diameter, but have a clearance above. The packing is effected by means of two rings B B with garter springs, which are contained in a comparatively shallow "pot" C. It is claimed that this packing will stand up to pressures as great as 20 atmospheres.—*August 22nd*, 1929.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTE OF BRITISH FOUNDRYMEN: SHEFFIELD AND DISTRICT SECTION.—King's Head Hotel, Sheffield. Presidential Address, by Mr. G. L. Oxley. 7.30 p.m.

INSTITUTE OF MARINE ENGINEERS.—Cinema Hall, Olympia, London, W. Lecture, "Modern Tanker Practice," by Mr. H. Barringer. 6.30 p.m.

TO-DAY AND SATURDAY, SEPTEMBER 28TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Institution meeting to be held in the Isle of Ely.

INSTITUTION OF NAVAL ARCHITECTS.—Summer meeting in Italy. For programme see page 380, April 5th, 1929.

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION Olympia.

TUESDAY, OCTOBER 1ST.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Automobile Club, Pall Mall, London, S.W. 1. Presidential address, "The Member and the Institution," by Professor W. Morgan. 8 p.m.

STAFFORDSHIRE IRON AND STEEL INSTITUTE.—Education Offices, St. James's-road, Dudley. Presidential Address by Mr. P. Jump. 7 p.m.

FRIDAY, OCTOBER 4TH.

DIESEL ENGINE USERS ASSOCIATION.—Caxton Hall, Westminster, London, S.W. 1. Paper, "Indicating Oil Engines, by Mr. G. B. Fox. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Engineering Experiences on a Tea Estate in Assam," by Mr. C. J. Hill. 7.30 p.m.

FRIDAY TO SUNDAY, OCTOBER 4TH TO 6TH.

COAL SMOKE ABATEMENT SOCIETY AND SMOKE ABATEMENT LEAGUE OF GREAT BRITAIN.—Palace Hotel, Buxton. Conference.

SATURDAY, OCTOBER 5TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—College of Technology, Sackville-street, Manchester. Presidential address by Mr. E. Longden. 4 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS. Visit to Corporation Gas Works at Partington. 2.30 p.m.

TUESDAY, OCTOBER 8TH.

ILLUMINATING ENGINEERING SOCIETY.—E.L.M.A. Lighting Service Bureau, 15, Savoy-street, Strand, London, W.C. 2. Report on Progress in Illuminating Engineering. 6.30 p.m.

INSTITUTE OF MARINE ENGINEERS.—85–88, The Minories, Tower-hill, London, E.C. 3. Paper, "Electric Propulsion as Applied to Passenger Liners," by Mr. Eskil Berg. 6.30 p.m.

THURSDAY, OCTOBER 10TH.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, 18, John-street, Adelphi, London, W.C. 2. Lecture, "The Range of Aircraft," by Mr. C. R. Fairey. 6.30 p.m.

FRIDAY, OCTOBER 11TH.

CHEMICAL ENGINEERING GROUP.—Burlington House, Piccadilly, London, W. 1. "Rationalisation—its Meaning and Application," by Mr. J. Davidson Pratt. 8 p.m.

MONDAY, OCTOBER 14TH.

INSTITUTE OF TRANSPORT.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Presidential address by Sir Josiah C. Stamp, D.Sc. 5.30 p.m.

WEDNESDAY, OCTOBER 16TH.

OVERHEAD LINES ASSOCIATION.—At the Institution of Electrical Engineers, Savoy-place, London, W.C. 2. Annual general meeting. 5.30 p.m.

THURSDAY, NOVEMBER 21ST.

BRITISH WATERWORKS ASSOCIATION.—Public Works Congress at the Agricultural Hall, London. Papers: "Water Supply as a Factor in Town and Regional Planning," by Mr. G. L. Pepler, F.S.I.; "The Preservation of Rivers and Streams from the Standpoint of Water Supply: Some Observations on River Pollution," by Dr. J. B. Firth; "The Purity of Drinking Waters from a Biological Aspect," by Dr. W. Rushton.

MODEL LOCOMOTIVE DRAWINGS.—We have received from Percival Marshall and Co., Ltd., publishers of the *Model Engineer*, two envelopes containing working drawings of a specially designed model locomotive, called the "Fayette." These envelopes are sold at 5s. each. The engine is a 2½in. gauge Anglo-American "Pacific," that is to say, she has the Baker valve gear—an American modification of the Walschaerts—and a Vanderbilt tender. She has hauled a load of five passengers. The drawings cover only the exceptional parts—the valve gear, boiler, &c.—the wheels, cylinders and several other items being made from standard castings. The boiler departs, of course, a good deal from actual boiler practice, but the design is interesting. A sheet of constructional notes accompanies the blue prints.